AFOSR 70-1816 TR

AD708177

Final Scientific Report on Grant AFOSR-68-1558

Disease Ecology of Tacaribe Group Viruses in Northwestern South America

1 May 1968 to 30 April 1970

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1. Introduction

The central theme of this project has been the study of various aspects of the disease ecology of the Tacaribe group of arboviruses. The Tacaribe group includes two viruses, Junin and Machupo, which have been found to be the etiological agents of severe human diseases, Argentinian and Bolivian haemorrhagic fevers. Other agents of the group are Tacaribe virus isolated from bats and mosquitoes in Trinidad, and Amapari virus known from rodents and certain of their ectoparasites from an area north of the mouth of the Amazon River in Brazil. In 1965 the present investigators found another agent of this group near Cali, Colombia, which they named Pichindé virus for the mountain valley from which it was first isolated. Since that time workers at the Middle America Research Unit and the National Communicable Disease Center have isolated additional viruses of the group from Paraguay and Florida (USA), although the descriptions of these agents have not yet been published.

With the exception of Tacaribe, these viruses have all been found to be associated with New World cricetine rodents and most of the field effort of the present investigators has therefore been directed toward the collection of indigenous small mammals to obtain materials for virological and serological study. For the authentication of the source of these materials, zoological study skins and skulls of animals captured have been prepared and catalogued. Ectoparasites associated with captured animals have also been collected and either preserved for taxonomic study or processed for possible virus isolation.

These field materials have values apart from the immediate purpose for which they were obtained: tissue specimens have yielded agents other than Tacaribe group viruses; serum specimens have been and will continue to be of use for serological study of the host and geographical distribution and incidence of a variety of viruses and other pathogens; mammal skins and skulls and ectoparasites are of use for taxonomic study by specialists in the various zoological and parasitological groups represented.

It may be noted that it had been anticipated that this project would be of three years duration, and that notification of its termination was received only two weeks before the end of the second grant year. Thus there is presently a backlog of field materials which have not yet been processed or otherwise studied. Also, because of the thirty-day-deadline for the submission of this report it must of necessity be incomplete. However, we are proceeding with the laboratory work up of material in hand and intend to submit supplemental reports of significant findings as they become available.

Existing field and laboratory records and data have been for the most part maintained either by units of work on a particular aspect of the general problem, or, in the case of long term activities, by calendar year. For a more meaningful presentation of results, records and data have been drawn upon for the periods relevant to each aspect of the work being reported.

The work on this project was conducted from two base laboratories, the virus laboratory of the Departamento de Microbiología of the Facultad de Medicina de la Universidad del Valle at Cali, and a subsidiary laboratory, referred to as the "Bogota Branch Laboratory", occupying facilities provided by the Instituto Colombiano Agropecuario at Bogota. Activities based at Cali were conducted by Drs. Carlos Sanmartin and Harold Trapido while those at the Bogotá Branch Laboratory were carried on by Dr. Ronald B. Mackenzie.

2. Studies of Pichinde Virus (Cali Laboratory)

2.1. Pichinde valley

2.1.1. Description of field study area

The principal field study area, the Pichinde valley (3° 25'N, 76° 35'W) lies within the Municipio de Cali, some 20 kilometers from our base laboratory at the Universidad del Valle in Cali. The portion of the valley from which host rodents have come lies between 1700 and 1900 meters in elevation on the eastern side of the western cordillera. The valley is in part occupied with small fincas where some coffee is grown as are various fruits, vegetables and flowers for the Cali market. However, much of the valley is covered with secondary forest resulting from the protection of regenerating vegetation to conserve water for the Cali water supply which draws on the Rio Pichinde, and there is also some primary forest along the steep slopes beside the main river and in the cool moist tributary ravines (quebradas). In the terminology of the Holdridge vegetation formation system the area is transitional between Subtropical and Lower Montane Wet Forest, or what is commonly termed "fog forest". The monthly cycles of temperature and rainfall at an observation station established at the 1750 meter level are shown in Table 1.

2.1.2. Materials and methods

Small mammals were captured using both Sherman and National folding live traps, usually baited with corn and plantain, although a variety of other baits incorporating particularly peanut butter and bacon were also tried at times. Animals captured were held in cages over white enamel pans of water up to five or six days and ectoparasitic engorged trombiculid mites and *Ixodes* ticks harvested from the water. Occasionally, other ectoparasites were recovered from the water as well, but, usually, the other ectoparasitic groups, including laelaptine mites, fleas, and staphylinid beetles of the genus *Amblyopinus* were combed from the fur at the time the animals were etherized for bleeding and/or sacrifice. In the field, animal organs and ectoparasites destined for virus isolation attempts were held and transported either on dry ice or in liquid nitrogen. In the laboratory, these materials were stored in a mechanical low temperature box at -60°C.

Wild animal tissue extracts were prepared at an approximate 10% w/v suspension in 10% fetal bovine serum in phosphate buffered saline, pH 7.2, containing 500 units of penicillin and 0.0005 g. of streptomycin per ml. Individual arthropods and pools up to 100 specimens were triturated in 1.5 ml of the same diluent. Tissue or arthropod suspensions were centrifuged for 30 minutes at 8,000 G in the cold (4°C).

Virus isolation attempts were carried out in 2-day-old suckling mice (Charles Rivers), 2-day-old golden hamsters (*Mesocricetus auratus*) or Vero cell monolayer tubes. The Vero cells were grown in Eagle's Minimum Essential Medium with 5% inactivated fetal bovine serum; for cell maintenance a 1% serum concentration was used.

Tissue extracts were inoculated either as original 1:10 suspensions or diluted to 1:100. Volumes of suspensions used for intracerebral (IC) inoculation of mice and hamsters were 0.02 and 0.03 ml respectively, and for Vero cell tubes 0.1 ml. Initially, inoculated mice and hamsters were observed for 21 days, but later for 14 to 16 days.

Immune ascitic fluid (IAF) was prepared by multiple intraperitoneal injection of mice with prototype virus strain An 3739. This fluid was used to identify all subsequent isolates.

Complement fixation (CF) tests were done with IAFs and crude mouse brain antigens prepared in veronal-buffer. Two units of complement were used with incubation at 4°C over-night.

Neutralization (N) tests were attempted in Vero cell cultures tubes employing the homologous IAF prepared at Cali.

Haemagglutination by the virus was investigated with sucrose-acetone extracted antigen by the method of Clarke and Casals.

The origins of the IAFs used in the characterization of the virus were the following: Group A, R-091, Yale Arbovirus Research Unit (YARU); Group B, R-0313, YARU; Group C, R-0312, YARU; Group Bunyamwera R-0292, YARU; Group Tacaribe, R-0058, YARU; Tacaribe, 42336, Trinidad Regional Virus Laboratory; Junin, TC 250, YARU; Machupo, MAF 121900, Middle America Research Unit (MARU); Amapari MG 42469, National Communicable Disease Center (NCDC).

2.1.3. Results

2.1.3.1. Isolation and characterization of the virus

All isolations of Pichinde virus have been from the cricetine rodent *Oryzomys albigularis* with a single exception, an isolation from another such rodent, *Thomasomys fuscatus*, which is ecologically associated with *Oryzomys albigularis* in the Pichinde valley.

On original IC inoculation, 2-day-old mice came down irregularly from the 7th to the 18th post-inoculation day, but most often from the 8th to the 12th day. Not uncommonly some mice in the positive litters did not become sick. On brain to brain passages in infant mice the virus tended to bring down the animals most frequently about the 8th day but some animals did not become sick until the 12th day and some survived. Passages were more readily maintained by 1:100 suspensions of infant mouse brain than by the 1:10 usually used in this laboratory. Adult mice were refractory to IC and intraperitoneal (IP) inoculation.

On original IC inoculation, 2-day-old hamsters became sick or died from the 6th to 15th postinoculation day, but most commonly from the 7th to the 12th day. Only very rarely were there survivors in positive litters.

Vero cells inoculated with passage material showed a clear cytopathic effect which began about the 4th day and was completed by the 6th or 7th day. Original suspensions of known positive material were also found to produce cytopathic effect.

To compare the effectiveness for virus isolation of the three systems described above, 48 specimens of original animal materials were processed in parallel. Virus was isolated from the same two specimens in the three systems; the remaining specimens were negative in all systems.

The success or failure in isolating Pichinde virus from brain, heart, lung, liver, spleen, kidney, adrenal, urine, serum and organ pools of a series of 7 known positive, naturally infected Oryzomys albigularis is shown in Table 2. The isolation method used for the organs in these trials was IC inoculation of infant mice with an approximate 1:10 w/v suspension in fetal bovine serum diluent; the urine and serum of animal HTC-1338 were also inoculated at the 1:10 dilution while the other sera were inoculated undiluted.

In the case of some Oryzomys albigularis shown to be naturally infected by virus recovery from blood, throat swabs were also taken. While virus was usually isolated from such throat swabs, it was noted that they were sometimes tinged with red, presumably blood, and it is therefore uncertain whether these isolations were from oropharyngeal secretions or from blood.

The virus was readily filterable through Seitz EK pads, was found to be sensitive to sodium desoxycholate (3.25 log inactivated), and withstood lyophilization.

Complement fixation tests with crude brain antigens of infected infant mice and immune ascitic fluids for A, B, C and Bunyamwera group viruses were negative. The preliminary identification was done by CF test in December 1966 when a low titer response (4/10) was obtained with a Tacaribe group IAF; there was no reaction with specific IAFs for Tacaribe, Junin, Machupo or Amapari viruses.

In the homologous CF testing of the virus, IAF and antigen titers were 1:128 and 1:10-40 respectively. Using the locally prepared IAF, neutralization of the cytopathic effect of the virus in Vero cells was not observed. Hemagglutination did not occur at 37°C in the pH range from 6.0 to 7.4

The virus was subsequently studied by Dr. Patricia A. Webb in N tests by the plaque reduction method. Included in her tests were all known members of the Tacaribe group: Tacaribe, Junin, Machupo, and Amapari, as well as Paraná from Paraguay and Tamiami from Florida, the descriptions of which have not yet been published. She found that, "No relationship between Pichinde and the other Tacaribe group viruses is demonstrable in these tests and Pichinde appears to be a distinct virus type". She further comments, "However, the possibility remains that if we had a hyperimmune serum with a higher homologous N antibody titer, some group interrelationships might be unmasked".

The virus was referred to Dr. Frederick A. Murphy of the National Communicable Disease Center, Atlanta, Georgia for electron microscopic study. Dr. Murphy succeeded in obtaining micrographs and advised us that, "The morphology and mode of develop are identical to other Tacaribe complex viruses we have examined".

While the virus could routinely be passed by IC inoculation of infant mice at dilutions of 10^{-1} to 10^{-3}, with mice most frequently coming down from the 8th to the 12th postinoculation day, it was noted that at the 10^{-1} dilution there were consistently deaths of portions of litters within 24 hours postinoculation, suggesting there may be a toxic factor associated with high concentrations of the virus in mouse brain.

The long duration of viremia in naturally infected <u>Oryzomys albigularis</u> is illustrated by the data presented in Table 3. A series of 4 animals, found to be viremic on first bleeding after being captured, were held alive in the laboratory and bled at intervals until death. Virus was consistently recovered from the serum of all animals until the time of their death; in the longest surviving individual virus was recovered 455 days after its capture. Urine specimens were obtained from 1 to 4 times from each of these animals; in no case was virus recovered.

In preliminary serological study of sera of wild caught <u>Oryzomys albigularis</u>, it was found that 3 of 10 sera which were positive by CF were from animals which were viremic.

2.1.3.2. Field studies.

2.1.3.2.1. Small mammals trapping.

Details of the small mammals trapping program in the Pichindé valley during 1968 and 1969 are given in Tables 4 to 15. These tables provide information on when and how many traps were set at the various fincas or quebradas in the valley (Tables 4 and 5), the relative success in capturing small mammals by month and trap type (Tables 6 and 7), the relative success of the two trap types in capturing each species of small mammal (Tables 8 and 9), the numbers of each species captured during each month in relation to the trapping effort expended (Tables 10 and 11), the numbers of each species captured at each locality (Tables 12 and 13), and the numbers of animals captured at each locality during each month (Tables 14 and 15).

Trapping was concentrated in forested quebradas which previous experience had shown to be the favored habit of *Oryzomys albigularis*, an enviroment in which small mammal population densities are low if the trapping methods used can be assumed to be effective; of all species, 1.6 animals were captured per 100 trap nights in 1968 and 2.0 in 1969 (Tables 8 and 9). National live traps were about four times as effective in capturing *Oryzomys albigularis* as Sherman traps, while the converse was true of the smaller *Thomasomys fuscatus* of which more than ten times as many were taken in Sherman traps than in the National traps.

Approximately one quarter of the animals captured were *Oryzomys albigularis*; trapping success for this species was 0.4 per 100 trap nights in 1968 and 0.5 in 1969. In selectively trapping for *Oryzomys* albigularis, the rodent species most frequently gotten in association with it was Thomasomys fuscatus of which approximately an equal number were captured in 1969 and a somewhat greater number in 1968.

Pichindé rodents noted as possibly pregnant at the time of capture were held alive to conception in the laboratory. Also, some specimens of each of the commoner species were paired in the laboratory in a variety of sorts of cages to determine if laboratory matings and conceptions could be accomplished. It was possible to obtain laboratory conceptions with four of the Pichindé rodent species, including Oryzomys albigularis, but not Thomasomys fuscatus. Data on field and laboratory conceptions, litter size and birth weights are given in Tables 16 and 17. Laboratory born rodents were toe clipped for individual identification and weighed daily until the 100th day of life. The extensive accumulation of data illustrating mean growth rates for each sex, and individual variation in growth rates are extensive and are not presented here.

Reproductive organs of Pichindé rodents were preserved at the time of their sacrifice for future study of reproductive patterns in the various species.

2.1.3.2.2. Virus isolations from small mammals.

Prior to the period of this report the only vertebrate from which Pichindé virus had been isolated was the cricetine rodent, Oryzomys albigularis, from which there were repeated isolations in all seasons of the year. During 1968 there were an additional 6 isolations from 47

Oryzomys albigularis, processed and in 1969 13 from 79. As before, the isolations were distributed throughout the year. During this two year period 134 Thomasomys fuscatus were processed which yielded one isolation of Pichindé virus from an animal captured in November 1968. This animal was from Finca Cárpatos where the virus has been repeatedly isolated from Oryzomys albigularis.

2.1.3.2.3. Ectoparasites.

Before this study was undertaken the small mammal ectoparasite fauna of the Western Cordillera in which the Pichindé Valley lies was almost entirely unknown. Ectoparasite groups found included laelaptine mites, trombiculid mites, ticks, lice, fleas and staphylinid beetles of the genus Amblyopinus. With a view to the possibility that ectoparasites might play a role in the transmission of Pichindé virus, intensive collections of ectoparasites were made. At first the ectoparasites were sorted to major groups and referred to taxonomic specialists in each group. Reports from these specialists have revealed the presence of a number of new species. Some of the ectoparasitic material is still under study and only provisional names are available. A listing of the previously described species, the new species, and the taxons provisionally code numbered is given in Table 19. With these identifications now in hand, a definitive report on the host-parasite relationships of Pichindé small mammals is now being prepaired.

2.1.3.2.4. Virus isolations from ectoparasites.

Following the taxonomic studies it became feasible to locally identify ectoparasites of most groups and these were then processed for possible virus isolation by species, species groups or genus. The numbers of ectoparasites and ectoparasite pools processed for possible virus isolation during 1968 and 1969 are shown in Tables 20 and 21, together with the hosts from which they were obtained. Isolations of Pichindé virus from ectoparasites collected in 1968 and 1969 are listed in Table 22. There were three isolations from pools of the laelaptine mite *Gigantolaelaps inca* and nine from pools of the tick *Ixodes tropicalis*. In the case of all 12 isolations, the ectoparasite host was *Oryzomys albigularis*, and in each case virus was recovered from the host as well as the ectoparasite pool. In three instances there were multiple isolations from ectoparasite pools derived from one host; two *Oryzomys albigularis* each yielded positive pools of *Gigantolaelaps inca*, *Ixodes tropicalis* nymphs and *Ixodes tropicalis* larvae, while pools of both nymphs and larvae of *Ixodes tropicalis* from a third *O. albigularis* were also positive.

Early in the work, ectoparasites were pooled and held at -60°C at the time they were recovered from their hosts. It was therefore equivocal whether virus isolations were from host blood in the arthropod gut, or the arthropod tissue itself. Later, the two ectoparasite species from which there had been virus isolations were held alive for several days after removal from the host. During 1969 two of the virus isolations from *Ixodes tropicalis* were from specimens which had been held alive at ambient temperatures for five days, and two for eight days before being pooled and held at $-60^{\circ}C$ until processed for virus isolation. These periods are sufficiently long to have permitted considerable digestion of host blood and there is therefore some suggestion that these isolations may represent infection of the ticks.

2.2. Laguna de la Cocha area, Nariño and Putumayo.

In May 1968, a two week field trip was made to Laguna de la Cocha, a lake at an elevation of 2,700 meters in the Department of Nariño near the Ecuadorian border in the Central Cordillera about 300 kilometers south of Cali and Pichindé. Collections were made in forested ravines and hillsides rising above the lake shore, and also in residual forest patches to the east, accessible from the road across the Cordillera from Pasto to Puerto Asís in the Amazon drainage. These forest habitats were somewhat higher (2,700 to 3,100 m.) than previous collecting areas at Pichindé but it was thought they would be suitable for *Oryzomys albigularis* as specimens have been recorded at elevations above 3,000 meters in Ecuador. Details of trapping effort, trapping success, and numbers and species of small mammal captured are given in Tables 23, 23a, and 24. While overall trapping success was of approximately the same order as that experienced in other fog forest localities, the species composition was disappointing. Of 54 small mammals captured in 3,508 trap nights, only one was *Oryzomys albigularis.* The bulk of the collection, 46 of 54 animals taken, were *Thomasomys cinereiventer* a species previously taken in association with *O. albigularis* at elevations of 1,900 to 2,500 meters at Munchique, but absent at the lower elevations usually trapped in the

Pichindé valley. Pichindé virus was not recovered from organ pools of any of the La Cocha area animals processed, although this was not unexpected as there was only one O. albigularis.

2.3. Guatapé, Antioquia.

A second probe to attempt to extend the known range of Pichindé virus was made in March 1969; this was to an area toward the northern end of the Central Cordillera near the town of Guatapé, in the Department of Antioquia, where a dam construction and hydroelectric project is in progress. Roads maintained for the construction project here gave access to relatively undisturbed fog forest at elevations at or near 1,900 meters, thought suitable for Oryzomys albigularis. Summaries of trapping effort, trapping success, and small mammal species captured are given in Tables 25,26 and 27. Of 39 small mammals taken, eight were Oryzomys albigularis; Pichindé virus was isolated from two of these, and from none of the animals of other species processed.

These results establish the occurrence of Pichindé virus in the Central Cordillera some 350 kilometers north of Pichindé and Cali, and further confirm the association of the virus with Oryzomys albigularis.

2.4. Attempts to determine possible human involvement.

Thus far, Pichindé virus has been isolated only from rodents and, in a few instances, from associated ectoparasitic arthropods. In the attempt to relate the virus to possible human infection, sera were collected from humans whose activities place them in close association with forest dwelling rodent populations known to be carrying the virus. One was a group of 37 persons resident on small fincas interspersed with forest in the Pichindé valley, including school age children, and another was a group of 45 laborers engaged in clearing forest in the basin of the Río Nare dam project near Guatapé in the Department of Antioquia. As immune fluid produces no neutralization of cytopathic effect in Vero cell tubes and Pichindé virus does not produce haemagglutinins, these human survey sera were tested by CF. (Antibodies to viruses of the Tacaribe group have been demonstrated by the plaque reduction method in other laboratories, but this technique has not been available at Cali.) In the CF tests used, the initial dilution of sera was 1:8. The 37 Pichindé sera were all negative. Of the 45 Guatape sera, one fixed complement in a dilution of 1:16 another in a dilution of 1:8 and a third showed traces of a reaction. If these results, which appear to be specific, can be confirmed by other serological methods, in particular the plaque reduction test, this would be the first indication of human infection by Pichindé virus.

2.5. Discussion and Summary.

Pichindé virus was first isolated in 1965 from specimens of the cricetine rodent *Oryzomys albigularis* captured in the Pichindé valley of the Western Cordillera of the Andes near Cali. In the intervening years the virus has been isolated from approximately 15 to 30 percent of the animals of this species from the Pichindé valley. With the exception of a single isolation from the rodent *Thomasomys fuscatus*, which is ecologically associated with Oryzomys albigularis in moist, cool forested mountain quebradas at altitudes of 1,700 to 2000 meters, all isolations of the virus have been from the latter species.

In a probe undertaken before the period of this report, the virus was also recovered from Oryzomys albigularis captured at Munchique, a locality in the Western Cordillera about 100 kilometers south of Cali. In the attempt to extend the known geographic range of the virus further south, small mammals were collected in the vicinity of Laguna de La Cocha, near the Ecuadorian border. Only one Oryzomys albigularis was gotten and virus was not recovered from it. In another field excursion to the vicinity of Guatapé near the northern and of the Central Cordillera, about 400 kilometers north of Cali, the virus was recovered from two of ten Oryzomys albigularis captured.

The considerable ectoparasite fauna of Oryzomys albigularis and associated small mammals includes laelaptine and trombiculid mites, ixodid ticks, fleas, amblyopinids, and uncommonly, lice. These have been studied by taxonomic specialists in the various groups and a series of new species described. Pichindé virus has been isolated from the laelaptine mite, Gigantolaelaps inca, and the tick, Ixodes tropicalis. In all cases the virus isolations have been from specimens removed from Oryzomys albigularis which were also infected. There is evidence of the virus persisting in Ixodes tropicalis for at least eight days after dropping off a viremic host.

Pichindé virus has been shown to be related to, but distinct from, other viruses of the Tacaribe group. The viremia in naturally infected Oryzomys albigularis is prolonged, virus having been recovered consistently at intervals up to 455 days after capture of the host. While virus has been recovered from urine removed from the bladder of infected Oryzomys albigularis at the time of sacrifice, viuria in animals with prolonged viremia was not observed.

3. Explorations for Tacaribe Group Viruses in Eastern Colombia, (Bogota Branch Laboratory).

3.1 Vertebrates collected

Of the 2,130 vertebrates collected a majority were small rodents and marsupials which were captured in National livetraps*. These wire mesh traps measured 6 x 6 x 12 inches and could be collapsed for carrying. They were usually set in lines transecting a variety of habitats, and spaces about 10 meters apart when an area was being trapped for the first time. Traps were then frequently shifted to the most productive habitats as experience dictated. Occasionally traps were placed on logs and tree branches, but most frequently they rested on the ground. While most of the traps were those described above, a few aluminum traps measuring 3 x 3 x 9 inches** were also used. They were more productive in certain habitats.

Several baits were tried, including peanut butter, cereal, meat, and mixtures of these, but sliced plantain was the most useful from the combined standpoint of ready availability and effectiveness.

Table 29 shows the degree of effectiveness of animal trapping by sites and months of the year. Precise records of the number of traps set were not maintained previous to September 1968 as they were subsequently. However a reasonable estimate has been made based on records and experience.

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* National Livetrap Co., Tomahawk, Wisconsin

** H.B. Sherman, Deland Florida.

The field team was headed by a single person throughout the study and marked changes in effort or methods probably did not occur. Field workers received an additional monetary reward for animals captured or killed. This was found to be desirable since some animals could never be trapped and could only be taken by night hunting, at times necessitating round-the-clock work by the field team.

Generally, in the llanos, fewer animals were taken per unit effort during the dry season months of January through March; whether this was because of population declines or dispersion, or a consequence of other factors was not established. Small animals appeared to be more abundant in the fertile, higher rainfall areas close to the mountains than in the relatively virgin, less fertile savannas to the east, where a certain amount of agricultural development has already taken place over a period of years. including the improvement of pastures and the planting of rice and cotton. Whether the apparent relative abundance of small vertebrates (principally rodents) in these areas is due to, or coincidental to, the agriculture and the human habitation can only be speculated upon. We found no indication of invasion of non-indigenous species.

In most cases trapping was done on large ranches, frequently engaging ranch personnel as field helpers and guides. A shelter or building was usually arranged for at the ranch where the electric generator, centrifuge, balance, gasoline stove (for boiling instruments), and portable work table were set up. Trapped animals were brought to this field station alive and held for a few hours (but occasionally more than a day) until they could be anesthetized with ether, bled from the heart and sacrificed. If quantities of blood were very small an amount of sterile unbuffered saline was added sufficient to result in a serum dilution of 1:2 or 1:4. Coagulated blood specimens were centrifuged, placed in screw-capped vials and kept in liquid nitrogen (N_2) for transportation to the Bogota laboratory. Organs were removed using boiled instruments, and placed either in sterile screw-capped vials or plastic-lined aluminum foil envelopes and also carried to Bogota in liquid N_2. Details of their subsequent processing is described under section, 3.2. Virus isolations.

For certain larger animals such as capybara and deer, and those which do not readily enter traps on the ground, the initial procedure was often different; the animal usually were shot, bled immediately from the heart with a syringe and then carried to the field station for subsequent procurement of tissue samples.

In most cases detailed measurements and weights were recorded along with habitat descriptions. The skull, scapula and humerus of each small mammal were carefully cleaned, bleached with hydrogen peroxide and numbered with india ink; the skins were labeled and treated with borax. Skins and skulls were used for definitive identification and taxonomic study, and then stored as a permanent record, available for future study. All pertinent data regarding the capture, description and identity of each animal are now being entered into an electric data processing system which will facilitate subsequent analysis.

3.2. Virus isolations

Through April 30, 1970, a total of 2,130 feral animal were captured, chiefly by live trapping. Of these, 183 were taken in the Departamento del Valle and processed in the Cali laboratory. Although some changes in methodology were made during the course of the study, the following tissues were usually taken: salivary gland, heart, lung, liver, spleen and kidney. In some cases, identical organs of different animals of the same species were pooled, in others the organs of a single animal were pooled, for processing. Tissues were triturated in phosphate buffered saline (PBS), either with 10 percent normal fetal calf serum or 0.75 percent of Fraction V, bovine plasma along with antibiotics. Suspensions were centrifuged at 5,900 G for 10 minutes. Though suckling hamsters (SH) were occasionally used, most tissue suspensions were inoculated into 2-4-day-old suckling mice (SM) by the intracerebral (IC) and intraperitoneal (IP) routes, each animal receiving a total of 0.05 ml of inoculum. Animals were checked daily for 21 days and those which were sick or suspicious were harvested for subsequent IC brain passage at dilutions of 10^{-1} and 10^{-2}.

Throat swabs were also collected using sterile cotton-tipped applicators which were immersed and held in PBS. Throat swabs were inoculated, either singly or in pools of 2 to 4, in the manner described for the tissues suspensions. Throat swabs and orga[illegible] about 500 animals still remain to be processed.

Of those processed to date, 14 strains of presumed virus have been isolated; data regarding them are summarized in Table 30. Of the first 6 strains itemized, none have yet been identified. Two are from separate organs of the same animal (RBM 0320, Dasyprocta fuliginosa) and appear to be identical. Preliminary work would suggest that none of the agents are members of the Tacaribe group. Strain BoAn 21-03-45 which was isolated from the spleen of Proechimys guayannensis, is of special interest. It reacts to high titer in complement fixation (CF) test with Venezuelan equine encephalitis (VEE) immune ascitic fluid and is tentatively identified as VEE virus. Reisolation from spleen was successful, while the throat swab as well as suspensions of salivary gland, heart, lung, liver and one kidney of the same animal were negative. The serum has not yet been tested. Collecting Site 22, where the animal was captured, is at an altitude of 520 m. in an area which has neither been known to be endemic for VEE virus nor had a history of a VEE epidemic. The area is sparsely populated but is undergoing rapid agricultural development.

Also of interest are the 3 strains isolated from throat swabs taken from 3 Thomasomys rodents all trapped on July 1, 1969 at Site 27, which is located about 30 km. south of Bogota at an altitude of 2,700 meters. The isolations all react to high titer with VEE virus immune mouse ascitic fluid and tentatively are considered to be VEE virus. These isolates are of particular interest because of the altitude at which they were made, and because there has been no suggestion of endemic or epidemic VEE activity in that region. However, it should be noted that the first isolation of VEE virus in Colombia, reported in 1942, was from a horse from the Bogota savanna.

Two others isolates deserve comment, BoAn 21-10-34 and BoAn 20-65-98, both of which reacted to high titer with vesicular stomatitis, type New Jersey (VSV-NJ) reference serum; one is from a pool of livers from 4 Proechimys guayannensis and the other from a suspension of viscera from a common opossum, Didelphis marsupialis. They were captured at the 2 Sites 19 and 20 during the months of June and July, 1968. The suspensions were inoculated into SM on November 14 and 6, 1968, respectively. In the case of the inoculated opossum tissue, all SM were dead or dying on the 3rd post-inoculation day. Of 8 SM inoculated with pooled Proechimys liver suspensions, 1 was missing in 24 hours while 2 were dead and the remaining 5 were sick. Three sick mice were harvested for passage; the remaining 2 sick mice recovered and lived until they were sacrificed at 24 days of age. Seventeen and 22 month after the capture of the animals, reisolations were tried, but were unsuccessful. However, it should be mentioned that during that interval refrigeration failures resulted in temperature changes which were unfavorable to stored specimens.

As may be seen in the section discussing vesicular stomatitis (VS) serology, 29 percent of all wild animals tested from Site 19 had VSV-NJ neutralizing (N) antibody while the frequency was 11 percent at Site 20. The N antibody rate among Proechimys at Site 19 was 55 percent. In view of this serological evidence of high VSV-NJ activity among small wild mammals at sites 19 and 20, and the rapidity with which inoculated SM became ill and died after inoculation with original material, it is not unreasonable to believe that the isolations of VSV-NJ from members of the genera Proechimys and Didelphis were valid, in spite of failure of reisolation.

We expect to continue work with these agents and eventually to identify all of them. Some of the above findings are of extreme interest, and follow-up work might well contribute to the knowledge of the natural history of the New Jersey type of vesicular stomatitis and of Venezuelan equine encephalitis; both,being agents which are known to be of importance in veterinary human and public health.

4. Vesicular Stomatitis Antibodies Among Domestic and Wild Animals of Eastern Colombia. (Collaborative Studies of the Bogota Branch Laboratory with the Middle America Research Unit).

4.1. Introduction

Sera of wild animals which were captured in the study have proven useful not only in the study of Tacaribe group viruses, but of other viral agents as well. Micro-serological methods make it possible to study antibodies in minute quantities of sera, thus rendering any sera collected more valuable.

This section deals with the use of some of the wild animal sera, along with domestic animal sera, in the study of another viral disease known to effect both domestic animals and humans, vesicular stomatitis (VS).

Vesicular diseases constitute a major disease problem of the cattle and swine industries of Colombia. Of vesicular disease outbreaks, 15 to 20 percent are due to VS, either of the New Jersey (VSV-NJ) or Indiana (VSV-Ind) serotypes; the remainder are due to foot-and-mouth disease. Colombia is in an extremely rapid phase of agricultural growth, which includes the development of a cattle industry in the great plains areas of Boyaca, Arauca, Meta and Vichada, as well as on the North Coast. Vesicular stomatitis outbreaks have been reported from all of these areas.

The Middle America Research Unit (MARU) of the U.S. Public Health Service, Canal Zone, Panama, has had an interest in, and has refined techniques for the study of the natural history of the vesicular stomatitis viruses. In an effort to learn more of VS natural history, some of the wild animal sera collected as a result of this study, as well as domestic animal sera, were tested at MARU under the supervision of Drs. Robert Tesh and Karl M. Johnson.

4.2. Study area

With a few exceptions the sera for study were collected in the Comisaria of Vichada and the Departamentos of Meta and Boyaca, Colombia, from domestic bovines and equines and from wild mammals and reptiles, between December 1966 and August, 1969. Exceptions are 23 animal and bird sera from the Monteria area in the Department of Cordoba and 8 adult human sera from Site 23 in Meta. The locations of the collecting sites are shown on the accompanying map (Fig. 3); with the exception of Monteria, all were located either in or adjacent to the foot-hills of the Eastern Cordillera of the Andes on land which was once forested, but which has now been cleared for cattle raising or agriculture, or in the "Llanos Orientales", which are extensive natural savannas broken mainly by patches of gallery forest or palm swamps.

While a few wild animal sera were collected at an altitude of 1,500 meters (Site 4), most were from altitudes between 200 and 600 meters, and in areas which are characterized by distinct dry and rainy seasons.

4.3. Collection of specimens

Small wild animals were live-trapped on the ground, and taken to a field station where they were bled and the serum separated. When serum quantities were small, sterile saline was added, and the dilution factor recorded. Larger wild animals were shot and bled immediately from the heart, in which case the whole non-refrigerated blood was taken within a few hours to a field station where sera were separated. Skins and skulls of feral animals were prepared for definitive identification.

One hundred-sixty-five bovines from 7 different herds were bled as well as 177 equines from 11 different farms. An attempt was made to obtain representative samples of the equine and bovine populations by age group. Ages of cattle were based on owner estimates and of horses by dental examination.

4.4. Antibody determinations

VSV and Cocal antibodies were measured at MARU by a modified plaque-neutralization (N) test using Vero cell monolayer cultures. Procedures of this test and methods used to prepare cell cultures have been described previously. The New Jersey serotype used in this study was Panama 3566, isolated from a bovine teat lesion during a vesicular stomatitis epizootic in Panama in 1961. The VSV-Ind used for testing was BT-78, originally isolated from Panamanian sandflies in 1959. A sub-type of the Indiana serotype known as Cocal virus was originally isolated in Trinidad; the original prototype strain of that virus, TRVL 40233, was kindly supplied by the Trinidad Regional Virus Laboratory and used for these tests.

Following heat inactivation at 56°C for 30 minutes, all sera were initially tested at a 1:16 dilution against the 3 viruses; plaque reduction of 95 percent or more was recorded as a positive test.

In testing wild animal sera at MARU, it had been observed that certain species have nonspecific, plaque reducing substance to VSV-NJ and that kaolin treatment of the sera removes these inhibitors. For this reason, wild animal sera which produced 95 percent or more plaque reduction of VSV-NJ were retested at 1:16 dilution after kaolin extraction. Only those sera positive in both tests were recorded as having specific VSV-NJ antibodies.

In testing serum specimens of laboratory animals (spiny rats, mice and guinea pigs) experimentally infected with VSV-Ind and Cocal viruses, MARU workers observed that these animals regularly developed high levels of neutralizing antibodies to the homologous virus and occasionally demonstrated low levels of antibody to the heterologous virus. For this reason, all sera which were positive to both VSV-Ind and Cocal at the 1:16 dilution were subsequently titrated against the two viruses in the plaque neutralization test at dilutions of 1:16, 1:32, 1:128, 1:512, 1:2048 and 1:8192. The virus neutralized by the highest serum dilution was interpreted as the specific infecting agent for purposes of Tables 31, 32, 33; a few sera had equal titers to VSV-Ind and Cocal and were recorded as positive to both agents in these tables.

4.5. Results

4.5.1. Feral animals

Tables 31, 32, and 33 show the prevalence of neutralizing antibody for VSV-NJ, VSV-Ind and Cocal virus among wild animals by collection site. VSV-NJ and Cocal virus antibody were each found among 7 percent of all animals tested, while VSV-Ind antibody was present amongh only 3 percent. While VSV-NJ antibody appears to have been widely distributed among the species tested, Cocal virus antibody was found chiefly in only 2 species, *Proechimys guayannensis* and *Didelphis marsupialis*. VSV-Ind appears to have involved several species, especially members of the genera *Oryzomys*, *Marmosa*, *Philander*, and *Didelphis*. While VSV-NJ and VSV-Ind antibody appear to have been present at most collecting sites, Cocal virus antibody seemed to be concentrated along the base of the Andes.

Figure 4 shows the proportionate number of domestic and wild animal sera among which N antibody to VSV-Ind and/or Cocal virus was demonstrated at a dilution of 1:16 or greater. While the relative amount of "overlap" was about the same among wild and domestic animals, there was a tendency for VSV-Ind antibody to appear alone among bovines and equines; on the other hand, Cocal antibody tended to be found alone among wild animal sera.

No vesicular stomatitis group antibody was found among the sera of 23 wild vertebrates captured in the Department of Cordoba. These included 1 Ameiva sp., 4 Zygodontomys brevicauda, 7 Rattus rattus, 2 Heteromys sp., 1 Alouatta seniculus and 8 brids tentatively identified as cattle agrets.

4.5.2. Domestic animals and humans

Sera from 342 bovines and equines collected close to or in the Andean foothills were tested and results by age are shown in Tables 34, 35, and 36. Overall rates of VSV-NJ and VSV-Ind antibody among these domestic animals were consistently several times higher than amongh wild animals in the same general areas. For these same a agents, rates among horses were consistently higher than among bovines. In contrast, Cocal antibody rates among domestic animal more nearly approximated those of wild animals and there was little difference between the rates in equines and bovines.

Though age dependence is not readily apparent, different patterns of antibody acquisition may be seen for equines and for bovines. Discounting animals less than one year of age, which could be circulating maternally acquired antibody, prevalence among horses increased steadily with age, whereas rates among cattle reached a plateau within the first 2 or 3 years of life.

Of the 8 human sera from Site 23, 6 demonstrated N antibody for VSV-NJ, 4 for VSV-Ind and 2 for Cocal virus.

4.6. Discussion

It is likely that the VSV-NJ results are interpretable. No major VSV-NJ sub-types are known and there is no reason to believe that the N antibodies encountered in these studies are not specific. Such being the case, it appears that VSV-NJ is rather broadly distributed in the llanos and foothills of eastern Colombia. Antibody was found among one third of the wild species tested, including those which are wholly terrestrial (Proechimys guayannensis and Nectomys squamipes). Few strictly arboreal animals were captured.

The absence of VSV-NJ antibody among 23 wild vertebrate sera (including 8 birds) from the Departamento de Cordoba (Site 24) and from near Pto. Carreño (Site 25) is interesting. Though in either instance the negativity might be the result of a small sample size, it is worth commenting that sera from bovine and equines from Site 24 showed VSV-NJ antibody levels of about 50 percent among animals 4 years of age and almost 100 percent among animals 8 years of age (in another study), indicating significant VSV-NJ activity. We have not yet tested domestic animal sera from Site 25 for VSV-NJ antibody.

The interpretation of VSV-Ind and Cocal virus N testing results is not easy. There appear to be a disproportionate number of sera which react with both VSV-Ind and Cocal antigens. In many cases the titers were either the same or differed by only 1 or 2 dilutions. These observations, along with the knowledge that at least 2 other VSV-Ind sub-types exist east of the Andes ("Alagoas" in Brazil and "Saldo" in Argentina) render these results difficult to interpret; one can only say that there appear to be at least two Indiana sub-types active in the Colombian foothills and llanos, and they appear to differ in their epidemiology. Studies in Panama by MARU scientists suggest that only one sub-type of the Indiana serotype exists in Panama and Central America, and furthermore it would appear that VSV-Ind there is naturally transmitted by sandflies which are members of the genus Phlebotomus. Serological studies there would indicate that VSV-Ind infects arboreal more frequently than terrestrial mammals. Work in Trinidad on the other hand, would indicate that the Trinidadian subtype (Cocal) of the Indiana type of VS virus has a basic cycle which involves terrestrial rodents.

Is it true that there is a spectrum of serological variants of the Indiana serotype east of the Andes and only one to the west and north? Would this imply that the original Indiana serotype evolved east of the Andes and that several sub-types subsequently evolved, each with its own distinct cycle in nature, and that only one of the subtypes "escaped" across the Andes to the west and north? It is likely that answers to these questions will come only with the collection and study of additional local strains and further serological testing.

ACKNOWLEDGEMENTS

Taxonomic specialists who have given valuable assistance in the identification of field materials are: for mammals, Dr. Jorge Hernandez C. of the Instituto de Ciencias Naturales, Universidad Nacional, Bogotá and Dr. Philip Hershkovitz of the Field Museum of Natural History, Chicago; for laelaptine mites, Dr. Deane P. Furman, Division of Parasitology, University of California, Berkeley; for trombiculid mites, Dr. James M. Brennan, Rocky Mountain Laboratory, U. S. Public Health Service, Hamilton, Montana; for fleas and lice, Sr. Eustorgio Mendez, Gorgas Memorial Laboratory, Panama; for staphylinid beetles, Dr. Alfredo Barrera of the Museo de Historia Natural de la Ciudad de Mexico, Mexico City and Dr. Carlos Machado-Allison of the Universidad Central de Venezuela, Caracas.

We are indebted to Drs. Karl Johnson and Robert Tesh of the Middle America Research Unit, Canal Zone, for their collaboration in the vesicular stomatitis study, to Dr. Patricia Ann Webb also of MARU for providing the results of her plaque neutralization tests of Pichindé and related viruses, and to Miss Clara Lesmes of the Cali Virus Laboratory for her participation in the laboratory aspects of the work on Pichindé virus.

The Instituto Colombiano Agropecuario (ICA) provided the facilities, some of the technical personnel and much of the equipment for work done in Bogotá.

Figure 1

Map 1

COLOMBIA

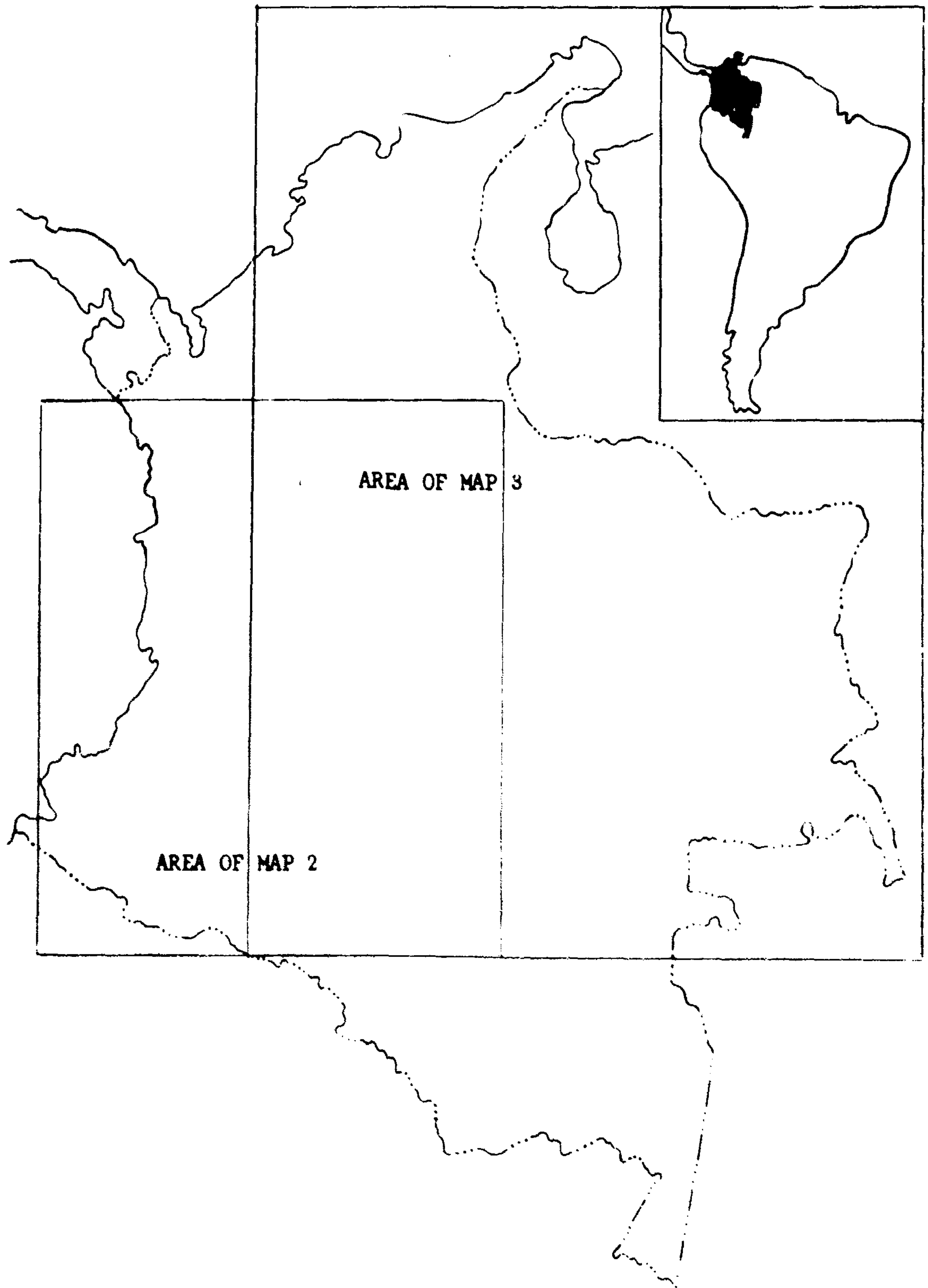
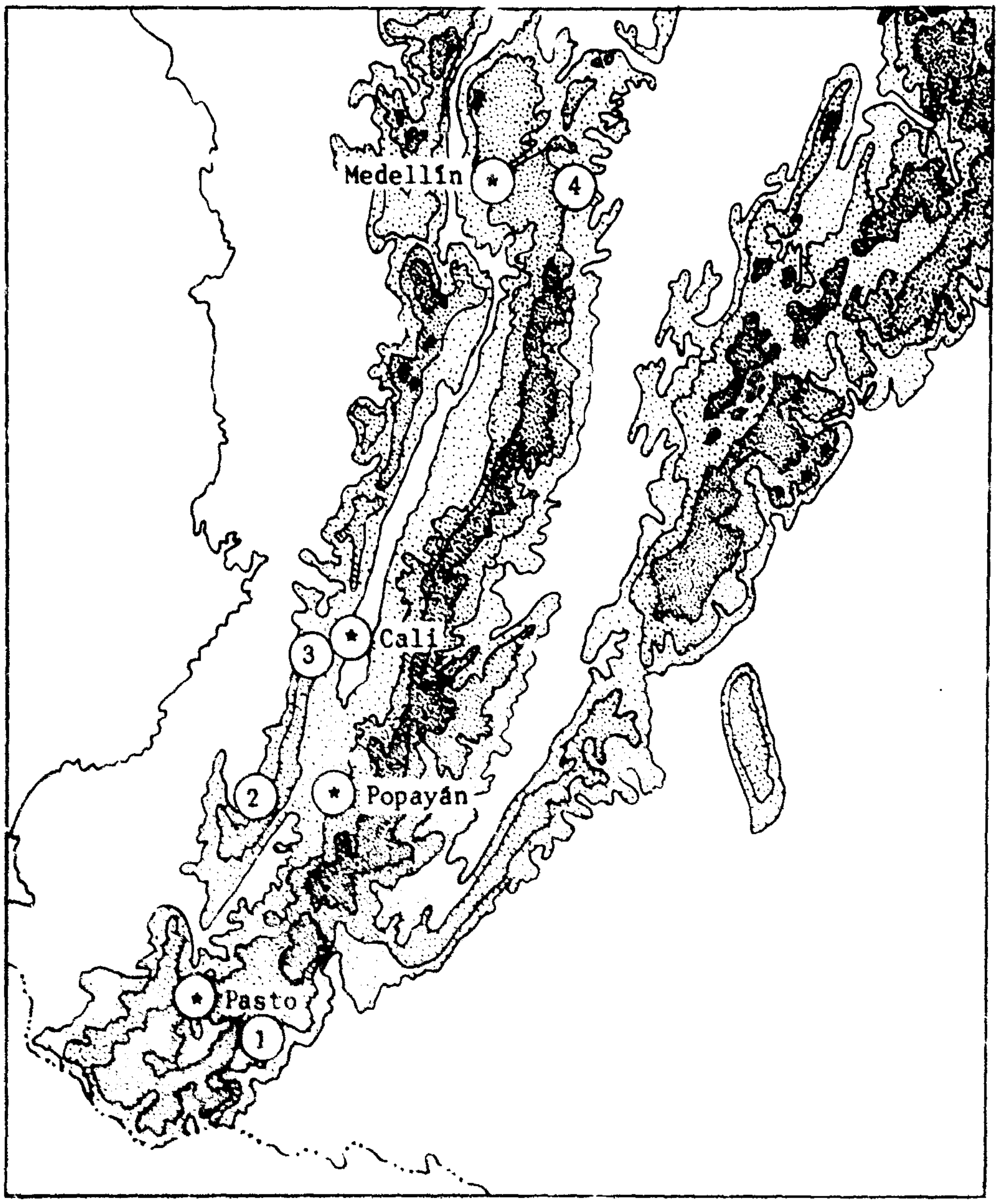


Figure 2

Map 2



1. Laguna de La Cocha
2. Munchique
3. Pichindé
4. Guatapé

Figure 3

ANIMAL CAPTURE LOCALITIES,
BOGOTA BRANCH LABORATORY.
COLOMBIA

For key to numbered localities see Table 28.

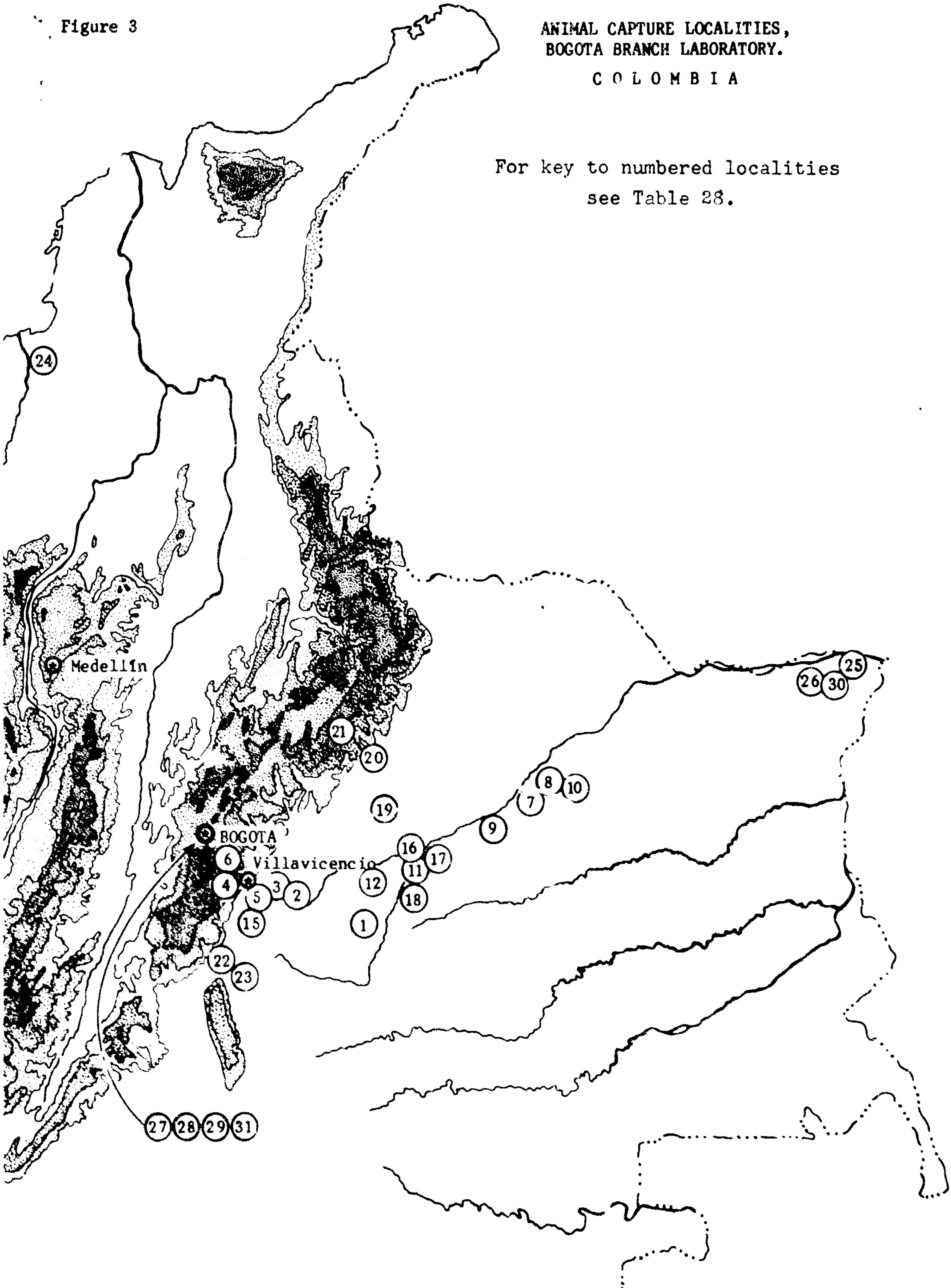
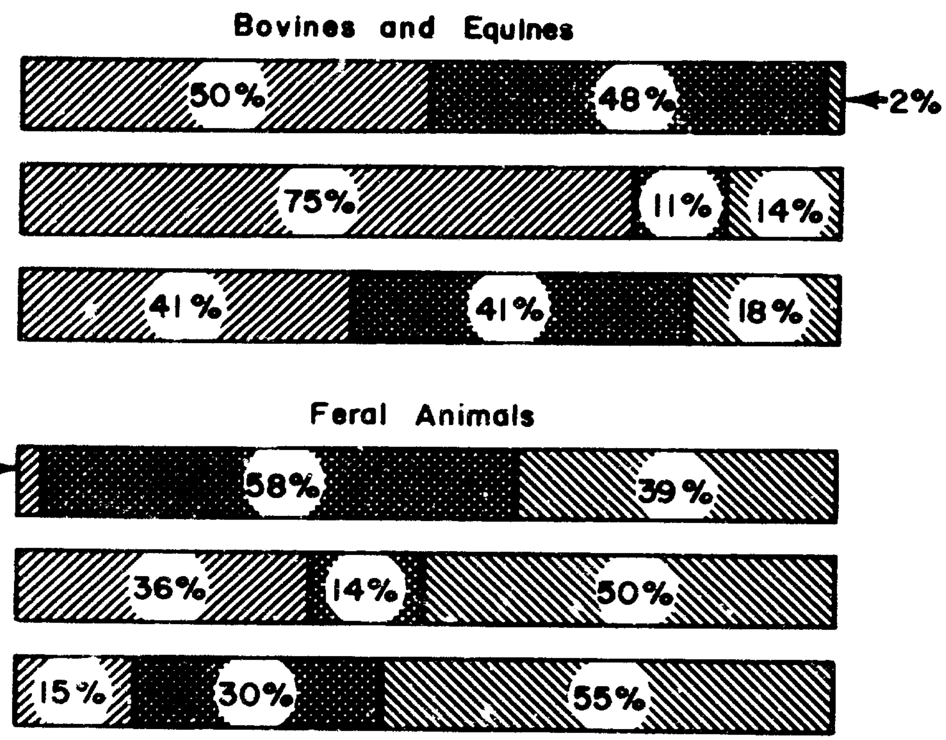


Figure 4

Frequency of Occurrence of VSV–Ind and Cocal Virus N Antibody among Domestic and Feral Animals from Three Different Areas.

Site Nº	Pos.* / Nº Tested	Percent. Pos.*
3+5	42/131	32
19	28/131	21
23	17/40	43
3	31/123	25
19	14/110	13
22+23	27/214	13



*VSV-Ind. and/or Cocal Antibody demonstrated

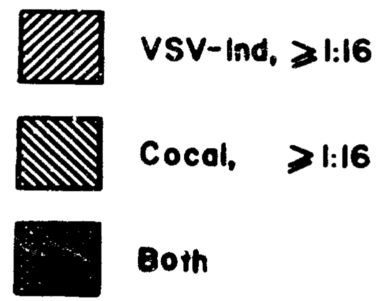


Table 1

Pichindé, Finca Brisas del Valle, Alt. 1750 m.

Meteorological Summary. Three Years (1967-1969)

	Temperature (°C)					Rain	
	Mean max.	Mean min.	Mean	Absolute max.	Absolute min.	Rain-fall (mm.)	No. of Rain Days
January	23.6	13.9	18.7	26	10	79.0	14
February	23.5	13.9	18.7	26	11	77.8	18
March	24.2	13.8	19.0	27	11	113.0	16
April	23.8	13.5	18.7	26	11	260.5	21
May	24.3	14.0	19.2	27	11	256.0	19
June	24.3	13.6	19.0	27	12	148.0	18
July	25.1	13.6	19.1	30	11	81.8	11
August	25.2	13.8	19.5	29	12	88.3	9
September	25.0	13.8	19.5	30	11	96.0	12
October	23.2	13.4	18.2	27	11	210.3	24
November	23.0	13.6	18.3	26	12	152.5	18
December	23.5	13.4	18.7	26	11	89.0	13
MEAN/TOTAL	24.1	13.7	18.9			1652.2	193

Table 2

Distribution of Pichindé Virus in Seven Virus Positive

Oryzomys albigularis

Field No. (HTC)	Brain	Heart	Lung	Liver	Spleen	Kidney	Adrenal	Urine	Serum	Organ Pool[1]
1338	ND	+	ND	+	+	+	ND	+	+	ND
1341	+	+	ND	+	+	+	ND	ND	+	ND
1376	+	+	ND	–	–	+	ND	ND	+	ND
1377	–	+	ND	+	+	+	ND	ND	–	ND
1379	+	–	ND	–	–	–	ND	ND	+	ND
1395	+	+	+	+	+	+	+	ND	+	+
1396	+	+	+	+	+	+	+	ND	+	+

+ = virus positive; – = virus negative; ND = not done.

1 = Organ pools included heart; liver, spleen and kidney.

Table 3

Duration of Viremia in *Oryzomys albigularis* Naturally Infected with Pichindé Virus

Host No.	HTC-1435		HTC-1641		HTC-1650		HTC-1662	
Age when Captured	Young Adult (87.4 gr.)		Adult (100.0 gr.)		Adult (129.2 gr.)		Young Adult (82.4 gr.)	
Sex	Male		Male		Male		Male	
Serial Blood Specimen	Lapsed Days	Viremia	Lapsed Days	Viremia	Lapsed Days	Viremia	Lapsed Days	Viremia
1st	32	+	7	+	10	+	10	+
2nd	53	+	24	+	21	+	30	+
3rd	66	+	44	+	41	+	111	+
4th	88	+	245	+	122	+		
5th	106	+	306	+	242	+		
6th	186	+	455	+	303	+		
7th	367	+						

N.B. Virus isolations in VERO cells and/or hamsters. Lapsed days calculated from date of capture.

+ = Virus isolated.

Table 4 - Pichindé

Trapping Effort by Month and Locality
1968

Locality \ Month	January	February	March	April	May	June	July	August	September	October	November	December	Total Trap Nights
Quebrada Norte No. 1	570	-	-	-	-	-	-	400	-	-	-	-	970
Quebrada Norte No. 2	1,500	1,040	-	-	-	-	-	-	-	-	-	-	2,540
La Flora	-	1,040	390	-	-	-	470	-	-	-	-	-	1,900
Bellavista	-	-	1,600	-	-	-	-	-	-	-	-	-	1,600
La Playa	-	-	-	300	-	-	-	-	280	-	-	-	580
Bosque CVC	-	-	-	410	-	-	-	-	471	-	640	-	1,521
La Margarita	-	-	-	1,370	110	-	-	-	-	-	-	240	1,720
La Esperanza	-	-	-	-	50	-	-	640	320	-	-	-	1,010
Valencia	-	-	-	-	-	-	-	-	120	400	-	-	520
El Danubio	-	-	-	-	-	-	-	-	-	560	80	-	640
El Abanico	-	-	-	-	-	-	-	-	-	800	-	-	800
Los Cárpatos	-	-	-	-	-	-	-	-	-	-	240	800	1,040
Total Trap Nights*	2,070	2,080	1,990	2,080	160	-	470	1,040	1,191	1,760	960	1,040	14,841

* National and Sherman traps combined.

Table 5 - Pichindé

Trapping Effort by Month and Locality
1969

Locality \ Month	January	February	March	April	May	June	July	August	September	October	November	December	Total Trap Nights
La Margarita	570	-	-	-	-	-	-	-	-	-	-	-	570
La Esperanza	360	-	-	-	-	-	-	-	-	-	-	150	510
Los Cárpatos	9[illegible]0	1,620	-	1,100	-	-	-	-	-	-	-	850	4,560
El Cairo	-	-	-	400	-	-	-	-	-	-	500	-	900
El Rincón del Yarumal	-	-	-	300	1,900	1,600	100	-	-	-	-	-	3,900
La Flora	-	-	-	-	-	-	1,900	-	700	-	-	-	2,600
Bosque CVC	-	-	-	-	-	-	-	-	800	800	500	-	2,100
Bellavista	-	-	-	-	-	-	-	-	100	900	-	-	1,000
La Tulia	-	-	-	-	-	-	-	-	-	500	-	-	500
El Caucho	-	-	-	-	-	-	-	-	-	-	500	-	500
El Cascabel	-	-	-	-	-	-	-	-	-	-	400	-	400
Total Trap nights*	1,920	1,620	-	1,800	1,900	1,600	2,000	-	1,600	2,200	1,900	100[illegible]	17,540

* National and Sh[illegible]rman traps combined.

Table 6 - Pichindé

Small Mammal Trapping Success, by Months and Trap Type
1968

	National Live Traps			Sherman Traps			TOTAL		
Month	No. Animals Captured	No. Trap Nights	*Percent Success	No. Animals Captured	No. Trap Nights	*Percent Success	No. Animals Captured	No. Trap Nights	*Percent Success
January	8	490	1.6	25	1,580	1.6	33	2,070	1.6
February	8	480	1.7	11	1,600	0.7	19	2,080	0.9
March	8	470	1.7	24	1,520	1.6	32	1,990	1.6
April	4	510	0.8	16	1,570	1.0	20	2,080	1.0
May	0	40	0.0	1	120	0.8	1	160	0.6
June	0	0	0.0	0	0	0.0	0	0	0.0
July	9	270	3.3	0	200	0.0	9	470	1.9
August	14	390	3.6	6	650	0.9	20	1,040	1.9
September	14	441	3.2	16	750	2.1	30	1,191	2.5
October	4	660	0.6	34	1,100	3.1	38	1,760	2.2
November	2	360	0.6	11	600	1.8	13	960	1.4
December	3	390	0.8	14	650	2.2	17	1,040	1.6
TOTAL	74	4,501	1.6	158	10,340	1.5	232	14,841	1.6

* Percent success = number of animals per 100 trap nights.

Table 7 - Pichindé

Small Mammal Trapping Success, by Months and Trap Type
1969

Month	National Live Traps			Sherman Traps			TOTAL		
	No. Animals Captured	No. Trap Nights	*Percent Success	No. Animals Captured	No. Trap Nights	*Percent Success	No. Animals Captured	No. Trap Nights	*Percent Success
January	34	1,030	3.3	0	890	-	34	1,920	1.8
February	8	900	0.9	2	720	0.3	10	1,620	0.6
March	-	-	-	-	-	-	-	-	-
April	8	900	0.9	8	900	0.9	16	1,800	0.9
May	14	950	1.5	30	950	3.2	44	1,900	2.3
June	10	800	1.3	20	800	2.5	30	1,[illegible]	1.9
July	34	1,000	3.4	27	1,000	2.7	61	2,000	3.1
August	-	-	-	-	-	-	-	-	-
September	30	800	3.8	22	800	2.8	52	1,600	3.3
October	16	1,100	1.5	26	1,100	2.4	42	2,200	1.9
November	13	950	1.4	9	950	0.9	22	1,900	1.2
December	19	500	3.8	22	500	4.4	41	1,000	4.1
TOTAL	186	8,930	2.1	166	8,610	1.9	352	17,540	2.0

* Percent success = number of animals per 100 trap nights.

Table 8 - Pichindé

Small Mammal Trapping Success, by Species and Trap Type
1968

Type of Trap	National Live Traps		Sherman Traps		TOTAL	
No. of Trap Nights	4,501		10,340		14,841	
Species	No. of Animals	*Percent Success	No. of Animals	*Percent Success	No. of Animals	*Percent Success
Oryzomys caliginosus	2	< 0.1	28	0.3	30	0.2
Oryzomys alfaroi	0	0.0	18	0.2	18	0.1
Oryzomys albigularis	37	0.8	22	0.2	59	0.4
Rhipidomys latimanus	0	0.0	1	< 0.1	1	< 0.1
Thomasomys fuscatus	2	< 0.1	83	0.8	85	0.6
Heteromys australis	3	< 0.1	2	< 0.1	5	< 0.1
Marmosa	2	< 0.1	2	< 0.1	4	< 0.1
Didelphis azarae	26	0.6	0	0.0	26	0.2
Icthyomys sp.	0	0.0	2	< 0.1	2	< 0.1
Mustela frenata	1	< 0.1	0	0.0	1	< 0.1
Cryptotis squamipes	1	< 0.1	0	0.0	1	< 0.1
TOTAL	74	1.6	158	1.5	232	1.6

* Percent success = number of animals per 100 trap nights.

Table 9 - Pichindé

Small Mammal Trapping Success, by Species and Trap Type
1969

Type of Trap	National Live Traps		Sherman Traps		TOTAL	
No. of Trap Nights	8,930		8,610		17,540	
Species	No. of Animals	*Percent Success	No. of Animals	*Percent Success	No. of Animals	*Percent Success
Oryzomys caliginosus	9	0.1	24	0.3	33	0.2
Oryzomys alfaroi	1	0.01	22	0.3	23	0.1
Oryzomys albigularis	77	0.9	19	0.2	96	0.5
Oryzomys munchiquensis	0	0	1	0.01	1	0.01
Rhipidomys latimanus	3	0.03	1	0.01	4	0.02
Thomasomys fuscatus	6	0.1	89	1.0	95	0.5
Thomasomys aureus	0	0	1	0.01	1	0.01
Thomasomys sp.	0	0	2	0.02	2	0.01
Heteromys australis	10	0.1	6	0.1	16	0.1
Didelphis azarae	69	0.8	0	0	69	0.4
Didelphis marsupialis	7	0.1	0	0	7	0.04
Marmosa	1	0.01	1	0.01	2	0.01
Mustela frenata	3	0.03	0	0	3	0.02
TOTAL	186	2.1	166	1.9	352	2.0

* Percent success = number of animals per 100 trap nights.

Table 10 - Pichindé

Monthly Composition of Small Mammal Captures by Species and Trapping Effort
1968

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
No. of Trap Nights*	2,070	2,080	1,990	2,080	16	-	470	1,040	1,191	1,760	960	1,040	14,841
Oryzomys caliginosus	4	-	8	11	-	-	1	1	1	2	2	-	30
Oryzomys alfaroi	6	5	-	2	-	-	-	2	1	-	-	2	18
Oryzomys albigularis	10	4	3	7	-	-	2	9	10	5	4	5	59
Rhipidomys latimanus	1	-	-	-	-	-	-	-	-	-	-	-	1
Thomasomys fuscatus	7	4	13	-	1	-	-	-	14	29	7	10	85
Heteromys australis	-	1	1	-	-	-	1	-	-	2	-	-	5
Marmosa	-	1	-	-	-	-	-	2	1	-	-	-	4
Didelphis azarae	4	4	4	-	-	-	5	6	3	-	-	-	26
Icthyomys sp.	1	-	1	-	-	-	-	-	-	-	-	-	2
Mustela frenata	-	-	1	-	-	-		-	-	-	-	-	1
Cryptotis squamipes	-	-	1	-	-	-	-	-	-	-	-	-	1
TOTAL	33	19	32	20	1	-	9	20	30	38	13	17	232

* National and Sherman traps combined.

Table 11 - Pichindé

Monthly Composition of Small Mammal Captures by Species and Trapping Effort
1969

	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
No. of Trap Nights*	1,920	1,620	-	1,800	1,900	1,600	2,000	-	1,600	2,200	1,900	1,000	17,540
Oryzomys caliginosus	2	-	-	1	-	1	-	-	2	11	4	12	33
Oryzomys alfaroi	-	-	-	5	1	1	4	-	1	5	5	1	23
Oryzomys albigularis	17	10	-	7	10	5	28	-	4	2	-	13	96
Oryzomys munchiquensis	-	-	-	-	-	-	-	-	-	-	-	1	1
Rhipidomys latimanus	-	-	-	-	-	-	-	-	1	2		1	4
Thomasomys fuscatus	1	-	-	1	25	19	16	-	18	10	1	4	95
Thomasomys aureus	-	-	-	-	-	-	-	-	1	-	-	-	1
Thomasomys sp.	-	-	-	-	-	-	-	-	-	2	-	-	2
Heteromys australis	-	-	-	-	7	3	4	-	2	-	-	-	16
Didelphis azarae	12	-	-	2	-	-	7	-	20	10	11	7	69
Didelphis marsupialis	1	-	-	-	-	-	2	-	3	-	1	-	7
Marmosa	1	-	-	-	-	-	-	-	-	-		1	2
Mustela frenata	-	-	-	-	1	1	-	-	-	-		1	3
TOTAL	34	10	-	16	44	30	61	-	52	42	22	41	352

* National and Sherman traps combined.

Table 12 - Pichindé

Small Mammal Captures by Species and Locality
1968

Locality	Number of Trap Nights*	*Oryzomys caliginosus*	*Oryzomys alfaroi*	*Oryzomys albigularis*	*Rhipidomys latimanus*	*Thomasomys fuscatus*	*Heteromys australis*	*Marmosa*	*Didelphis azarae*	*Icthyomys* sp.	*Mustela frenata*	*Cryptotis squamipes*	Total Animals
Quebrada Norte No. 1	970	2	4	7	-	-	-	-	5	-	-	-	18
Quebrada Norte No. 2	2,540	3	6	7	1	11	-	1	4	1	-	-	34
La Flora	1,900	1	3	o	-	-	2	-	7	-	-	-	19
Bellavista	1,600	8	-	3	-	13	1	-	3	1	1	1	31
La Playa	580	1	-	5	-	2	-	-	-	-	-	-	8
Bosque CVC	1,521	4	2	7	-	15	-	1	3	-	-	-	32
La Margarita	1,720	9	1	6	-	-	-	-	-	-	-	-	16
La Esperanza	1,010	-	-	5	-	1	-	2	4	-	-	-	12
Valencia	520	-	-	5	-	6	-	-	-	-	-	-	11
El Danubio	640	2	-	1	-	6	-	-	-	-	-	-	9
El Abanico	800	-	-	2	-	21	2	-	-	-	-	-	25
Los Cirpatos	1,040	-	2	[illegible]	-	10	-	-	-	-	-	-	17
TOTAL	14,841	30	18	59	1	85	5	4	26	2	1	1	232

* National and Sherman traps combined.

Table 13 - Pichindé

Small Mammal Captures by Species and Locality
1969

Locality	Number of Trap Nights*	*Oryzomys caliginosus*	*Oryzomys alfaroi*	*Oryzomys albigularis*	*Oryzomys munchiquensis*	*Rhipidomys latimanus*	*Thomasomys fuscatus*	*Thomasomys aureus*	*Thomasomys* sp.	*Heteromys australis*	*Didelphis azarae*	*Didelphis marsupialis*	*Marmosa*	*Mustela frenata*	Total Animals
La Margarita	570	-	-	2	-	-	1	-	-	-	2	1	-	-	6
La Esperanza	510	5	-	6	-	1	-	-	-	-	6	-	2	-	20
Los Cárpatos	4,560	10	6	37	1	-	4	-	-	-	12	-	-	1	71
El Cairo	900	2	-	-	-	-	-	-	-	-	1	-	-	-	3
El Rincón del Yarumal	3,900	1	2	17	-	-	46	-	-	10	-	-	-	2	78
La Flora	2,600	-	4	30	-	-	18	1	-	4	13	5	-	-	75
Bosque CVC	2,100	4	5	4	-	2	17	-	-	2	24	-	-	-	58
Bellavista	1,000	7	-	-	-	-	9	-	2	-	7	-	-	-	25
La Tulia	500	2	1	-	-	1	-	-	-	-	1	-	-	-	5
El Caucho	500	2	5	-	-	-	-	-	-	-	3	1	-	-	11
El Cascabel	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	17,540	33	23	96	1	4	95	1	2	16	69	7	2	3	352

Table 14 - Pichindé

Small Mammal Captures by Month and Locality

1968

Locality \ Month	January	February	March	April	May	June	July	August	September	October	November	December	Total Animals
Quebrada Norte No. 1	9	-	-	-	-	-	-	9	-	-	-	-	18
Quebrada Norte No. 2	24	10	-	-	-	-	-	-	-	-	-	-	34
La Flora	-	9	1	-	-	-	9	-	-	-	-	-	19
Bellavista	-	-	31	-	-	-	-	-	-	-	-	-	31
La Playa	-	-	-	4	-	-	-	-	4	-	-	-	8
Bosque CVC	-	-	-	2	-	-	-	-	20	-	10	-	32
La Margarita	-	-	-	14	-	-	-	-	-	-	-	2	16
La Esperanza	-	-	-	-	1	-	-	11	-	-	-	-	12
Valencia	-	-	-	-	-	-	-	-	6	5	-	-	11
El Danubio	-	-	-	-	-	-	-	-	-	8	1	-	9
El Abanico	-	-	-	-	-	-	-	-	-	25	-	-	25
Los Cárpatos	-	-	-	-	-	-	-	-	-	-	2	15	17
TOTAL	33	19	32	20	1	-	9	20	30	38	13	17	232

Table 15 - [illegible]chindé

Small Mammal Captures by Month and Locality
1969

Locality \ Month	January	February	March	April	May	June	July	August	September	October	November	December	Total Animals
La Margarita	6	-	-	-	-	-	-	-	-	-	-	-	6
La Esperanza	12	-	-	-	-	-	-	-	-	-	-	8	20
Los Cárpatos	16	10	-	12	-	-	-	-	-	-	-	33	71
El Cairo	-	-	-	1	-	-	-	-	-	-	2	-	3
El Rincón del Yarumal	-	-	-	3	44	30	1	-	-	-	-	-	78
La Flora	-	-	-	-	-	-	60	-	15	-	-	-	75
Bosque CVC	-	-	-	-	-	-	-	-	31	18	9	-	58
Bellavista	-	-	-	-	-	-	-	-	6	19	-	-	25
La Tulia	-	-	-	-	-	-	-	-	-	5	-	-	5
El Caucho	-	-	-	-	-	-	-	-	-	-	11	-	11
El Cascabel	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	34	10	-	16	44	30	61	-	52	42	22	41	352

Table 16

Biometric Data on Laboratory Conceived Litters of *Oryzomys albigularis* (Parent Stock from Pichindé)

Birth Weights

	Males	Females	TOTAL
Number Born	29	36	65
Mean Birth Wt. (gms.)	5.2	5.1	5.1
Min. Birth Wt. (gms.)	4.2	4.1	4.1
Max. Birth Wt. (gms.)	6.0	6.0	6.0

Litter Size

No. in Litter	1	2	3	4	5	6	TOTAL Litters
No. of Litters	1	0	3	5	9	4	22

Table 17

Biometric Data on Litters of Pichinde Rodents other than *Oryzomys albigularis*

	Number of Litters			Number of Individuals			Litter Size			Birth Weight in Grams		
	Conceived in Field	Conceived in Lab.	Total	Conceived in Field	Conceived in Lab.	Total	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Oryzomys alfaroi	5	14	19	19	59	78	2	5	4.1	2.4	4.4	3.30
Oryzomys munchiquensis	5	17	22	16	49	65	1	4	3.0	1.3	2.0	1.71
Oryzomys caliginosus	16	0	16	46	0	46	2	4	2.9	3.5	5.1	4.39
Reithrodontomys mexicanus	0	4	4	0	9	9	2	3	2.3	1.1	1.6	1.36

Table 18

Pichindé. Virus Isolations from Vertebrates

	Number Positive/Number Processed			
	Oryzomys albigularis		*Thomasomys fuscatus*	
	1968	1969	1968	1969
January	1/8	3/15	0/6	0/0
February	0/3	2/9	0/1	0/0
March	1/3	0/0	0/11	0/0
April	0/5	1/4	0/0	0/1
May	0/0	0/10	0/1	0/22
June	0/0	0/5	0/0	0/17
July	0/2	2/21	0/0	0/13
August	1/9	0/0	0/0	0/0
September	1/6	0/3	0/10	0/11
October	0/4	1/1	0/20	0/7
November	1/4	0/0	1/4	0/1
December	1/3	4/11	0/6	0/3
TOTAL	6/47	13/79	1/59	0/75

NB. Virus not isolated from other species processed.

Table 19

Identifications of Ectoparasites from Small Mammals

Species \ Locality	Pichindé	El Silencio El Jordán	Munchique	Laguna de La Cocha	Guatapé
Ixodes ticks					
Ixodes tropicalis	+	+	+		+
Ixodes andinus		+	+	+	
Lelaptine mites					
Gigantolaelaps inca	+	+	+	+	+
Gigantolaelaps wolffsohni	+		+		
Gigantolaelaps trapidoi, sp. n.	+				
Gigantolaelaps spp.	+	+			
Mysolaelaps parvispinosus	+		+		
Mysolaelaps heteronychus	+	+	+		
Mysolaelaps spp.	+				
Laelaps castroi	+				
Laelaps thori	+	+	+		
Laelaps sp. 7	+				
Laelaps sp. 4	+				
Laelaps sp. near castroi	+			+	
Laelaps sp. 5 near pilifer			+		
Laelaps spp.	+				
Eubrachylaelaps rotundus	+				
Eubrachylaelaps sp.	+				+
Trombiculid mites					
Trombicula dunni	+				
Trombicula near dunni	+				
Trombicula almae	+				
Trombicula desdentata			+		
Trombicula sp.			+		
Eutrombicula goeldii	+				
Euschoengastia flochi	+				
Euschoengastia pichindensis sp. n.	+		+		
Euschoengastia trapidoi sp. n.	+				
Euschoengastia palmae			+		
Euschoengastia sp.	+				
Pseudoschoengastia bulbifera	+				
Pseudoschoengastia oopsi sp. n.	+				
Pseudoschoengastia sp.	+				
Fonsecia (Parasecia) manueli	+				
Vanidicus tricosus	+				
Polylopadium tertium sp. n.	+				
Odontocarus mundrignensis			+		
Hoffmannina sp., near handleyi			+		
[illegible]tiscus sp.			+		

Table 19 (continued)

Identifications of Ectoparasites from Small Mammals

Species \ Locality	Pichindé	El Silencio El Jordan	Munchique	Laguna de La Cocha	Guatapé
Intercutestrix tryssa	+				
Trombiculid spp.	+	+		+	+
Pseudoscorpions					
Chelanops columbicus sp. n.				+	
Amblyopinini beetles					
Amblyopinus emarginatus	+		+		
Amblyopinus delicatus, sp. n.	+		+		
Amblyopinus waterhousei	+		+		
Amblyopinus trapidoi sp. n.	+	+	+	+	+
Amblyopinus spp.	+	+		+	+
Siphonaptera (Fleas)					
Polygenis thurmani	+				
Polygenis pradoi	+				
Polygenis bohlsi bohlsi	+				
Polygenis dunni	+				
Polygenis roberti beebei	+		+		
Neotyphloceras rosenbergi	+		+	+	
Xenopsylla cheopis	+				
Scolopsyllus colombianus sp. n.	+				
Cleopsylla monticola			+	+	
Pleochaetis smiti			+		
Plocopsylla thor			+	+	
Dasypsyllus gallinulae perpinnatus			+		
Sphinctopsylla tolmera				+	
Pulex simulans				+	
Pleochaetis apollinaris				+	
Ctenidiosomus rex				+	
Siphonaptera sp.		+		+	+

Table 20

Pichinde
Summary of Ectoparasites from Small Mammals Captured During 1968 and Processed for Possible Virus Isolation

Hosts \ Ectoparasites	*Gigantolaelaps inca*	*Gigantolaelaps* sp. A.	*Laelaps* spp.	*Eubrachylaelaps* sp.	*Mysolaelaps* sp.	*Amblyopinus* spp.	*Amblyopinus waterhousei*	*Siphonaptera* spp.	*Neotyphloceras rosenbergi*	*Polygenis* spp.	*Trombiculids*	*Ixodes tropicalis* L.	*Ixodes tropicalis* N.	*Ixodes tropicalis* ♀	TOTAL
Oryzomys albigularis	611/37					48/22		12/6			153 /9	445/39	175/37		1444 /145
Oryzomys alfaroi		27/6	6/2									38/5	10/4		81 /18
Oryzomys caliginosus			>11[illegible]2	72/2		16/8		2/2	2/1	2/2		12/6			> 221/ 23
Thomasomys fuscatus	1/1		483/25			32/19		14/9	7/5	2/1	120 /7	304/53	3/3		996 /123
Rhipidomys latimanus			5/1		2/1										7 /2
Didelphis azarae						4/2	11/1				500-1000 /3	111/10	143/11	8/5	500-1000 /32
Marmosa												6/1	1/1	1/1	[illegible] /3
TOTAL	612/33	27/6	>609/30	72/2	2/1	100/51	11/1	28/17	9/6	4/3	500-1000 /19	916/115	332/56	9/6	3504-4004 /346

Table 21

Pichinde

Summary of Ectoparasites from Small Mammals Captured During 1969 and Processed for Possible Virus Isolation

Hosts \ Ectoparasites	*Gigantolaelaps* sp.	*Gigantolaelaps* sp. A.	*Gigantolaelaps inca*	*Mysolaelaps heteronychus*	*Mysolaelaps* sp.	*Laelaps castroi*	*Amblyopinus* spp.	*Siphonaptera*	*Trombiculids*	*Ixodes tropicalis* L.	*Ixodes tropicalis* N.	*Ixodes tropicalis* ♀	TOTAL
Oryzomys albigularis			1853/92				121/44	21/19	64/3	543/59	168/48	2/1	2763/266
Oryzomys alfaroi	35/12	4/2					1/1	1/1		58/14	8/4		107/34
Oryzomys caliginosus							16/8	19/13		4/3			39/24
Oryzomys munchiquensis	1/1												1/1
Thomasomys fuscatus							43/21	41/22		287/51	1/1		372/95
Thomasomys aureus											1/1		1/1
Rhipidomys latimanus	2/1			11/2	1/1	10/1		12/3		8/1	4/1		48/10
Didelphis azarae									453/5	161/12	66/11	4/1	684/29
Didelphis marsupialis							1/1		28/1	10/1	1/1		40/4
Heteromys australis										6/1			6/1
TOTAL	38/14	4/2	1853/92	11/2	1/1	10/1	182/75	94/58	545/9	1068/142	249/67	6/2	4061/465

NB. Number of ectoparasites/number of pools. L. = Larvae. N. = Nymphs.

Table 22

Pichindé. Virus Isolations from Ectoparasites
1968-1969

Host No. (HTC-)	Pool No. (Ar.)	Ectoparasite Species	No. Species in Pool	Date Host Captured
2234	9663	*Gigantolaelaps inca*	8 Ad.	8 Mar. 1968
"	9666	*Ixodes tropicalis*	7 NN	" " "
"	9667	*Ixodes tropicalis*	17 LL	" " "
2788	11628	*Ixodes tropicalis*	12 NN	13 Sept. 1968
"	11629	*Ixodes tropicalis*	20 LL	" " "
2865	12900	*Ixodes tropicalis*	4 NN	28 Nov. 1968
2940	13551	*Ixodes tropicalis*	11 LL	28 Apr. 1969
"	13552	*Ixodes tropicalis*	5 NN	" " "
"	13945	*Gigantolaelaps inca*	10 Ad.	" " "
3230*	14083	*Gigantolaelaps inca*	14 Ad.	23 July 1969
3380	14902	*Ixodes tropicalis*	11 LL	24 Oct. 1969
3428	15087	*Ixodes tropicalis*	5 NN	10 Dec. 1969

Ad. = Adults; LL = Larvae; NN = Nymphs

* Under study.

Table 23

La Cocha and Vicinity, Nariño and Putumayo

Trapping Effort by Locality
May 1968

Trap Type / Locality	National 12"	Sherman	Snap Trap, Large	Snap Trap, Small	Total Trap Nights
El Naranjal (2,700 m.)	384	660	-	-	1,044
Sta. Lucia (2,700 m.)	320	385	-	-	705
Sitio No.1 (Páramo, K. 33) (2,[illegible]00 m.)	136	360	-	-	496
Sitio No.2 (Páramo, K. 38) (3,100 m.)	140	320	-	-	460
Sitio La Isla (2,700 m.)	-	-	50	50	100
Quebrada Si[illegible]eria K. 77 (2,200 m.)	193	510	-	-	703
Total Trap Nights	1,173	2,235	50	50	3,508

Table 33a

La Cocha and Vicinity, Nariño and Putumayo

Small Mammal Captures by Species and Localities
May 1968

	Oryzomys albigularis	*Thomasomys cinereiventer*	*Thomasomys aureus*	*Oryzomys* sp.	*Caelonestes* sp.	*Thrinocodus* sp.	Total Capture	Trap Nights
El Naranjal. Alt. 2700 m.	1	0	0	0	0	0	1	1044
Sta. Lucia. Alt. 2700 m.	19	16	3	2	0	6	46	705
Sitio No. 1. Páramo K.33 Alt. 2900 m.	0	1	0	0	0	0	1	495
Sitio No. 2. Páramo K.38 Alt. 3100 m.	0	0	1	1	1	0	3	460
Sitio La Isla. Alt. 2700 m.	0	0	2	0	0	0	2	100
Quebrada Siberia. Alt. 2200 m.	1	0	0	0	0	0	1	703
TOTAL	21	17	6	3	1	6	54	3508

Table 24

La Cocha and Vicinity, Nariño and Putumayo

Small Mammal Trapping Success by Species and Trap Type.
All Collecting Sites Combined
May, 1968

Trap Type	National 12"		Sherman		Snap Trap, Large		Snap Trap, Small		Total	
No. Trap Nights	1,173		2,235		50		50		3,508	
Species	No. of Animals	*Percent Success	No. of Animals	*Percent Success	No. of Animals	*Percent Success	No. of Animals	*Percent Success	No. of Animals	*Percent Success
Oryzomys albigularis	1	0.1	0	0.0	0	0.0	0	0.0	1	0.03
Thomasomys cinereiventer	22	1.9	24	1.1	0	0.0	0	0.0	46	1.30
Thomasomys aureus	1	0.1	0	0.0	0	0.0	0	0.0	1	0.03
Oryzomys sp.	0	0.0	2	0.1	0	0.0	1	2.0	3	0.10
Caelonestes sp.	0	0.0	2	0.1	0	0.0	0	0.0	2	0.06
Thrinocodus sp.	1	0.1	0	0.0	0	0.0	0	0.0	1	0.03
TOTAL	25	2.1	28	1.3	0	0.0	1	2.0	54	1.50

*Percent success = number of animals per 100 trap nights.

Table 25

Guatapé, Antioquia

Trapping Effort
March, 1969

Locality \ Trap Type	National 12"	Sherman	TOTAL Trap Nights
Campamento Miraflores (1,900 m.)	457	713	1,170
Sta. Rita (1,880 m.)	654	436	1,090
Total trap nights	1,111	1,149	2,260

Table 26

Guatapé, Antioquia

Trapping Success by Species and Trap Type - All Collecting Sites Combined
March, 1969

Type of Trap	National Live Traps		Sherman Traps		TOTAL	
No. Trap Nights	1,111		1,149		2,260	
Species	No. of Animals	*Percent Success	No. of Animals	*Percent Success	No. of Animals	*Percent Success
Oryzomys albigularis	7	0.6	1	0.1	8	0.4
Rhipidomys latimanus	3	0.3	2	0.2	5	0.2
Thomasomys fuscatus	1	0.1	4	0.3	5	0.2
Thomasomys aureus	4	0.4	0	0.0	4	0.2
Oryzomys caliginosus	2	0.2	6	0.5	8	0.4
Heteromys anomalus	5	0.5	0	0.0	5	0.2
Didelphis azarae	3	0.3	0	0.0	3	0.1
Marmosa	0	0.0	1	0.1	1	0.04
TOTAL	25	2.3	14	1.2	39	1.7

* Percent success = number of animals per 100 trap nights.

N.B. Species identifications other than Oryzomys albigularis are provisional.

Table 27

Guatapé, Antioquia

Species Composition of Small Mammal Captures
March, 1969

	Campamento Miraflores Alt. 1,900 m. (1,170 trap nights)	Sta. Rita Alt. 1,880 m. (1,090 trap nights)	TOTAL (2,260 trap nights)
Oryzomys albigularis	2	6	8
Rhipidomys latimanus	5	0	5
Thomasomys fuscatus	0	5	5
Thomasomys aureus	0	4	4
Oryzomys caliginosus	7	1	8
Heteromys anomalus	0	5	5
Didelphis azarae	1	2	3
Marmosa	0	1	1
TOTAL	15	24	39

N.B. Species identifications other than *Oryzomys albigularis* are provisional

Table 28

Bogota Branch Laboratory, Collecting Sites of Vertebrates.

1967-1970.

(See map, Figure 3)

1. Hdas. La Maria, Valdivia and Nabole.
   Savanna and gallery forest; alt. 300 m.; $72^{o}15'W \times 3^{o}50'N$.

2. Hda. Ponteadero.
   Savanna and gallery forest; alt. 500 m.; $72^{o}58'W \times 4^{o}5'N$.

3. Hda. Santa Clara.
   Savanna and gallery forest; alt. 500 m.; $73^{o}35'W \times 4^{o}6'N$.

4. Hda. Buenavista.
   Foothills, forested; alt. 1,080 m.; $73^{o}40'W \times 4^{o}10'N$.

5. Hdas. Tanamé, San Antonio and La Libertad.
   Savanna and gallery forest; alt. 500 m.; $73^{o}30'W \times 4^{o}5'N$.

6. Finca Monte Redondo.
   Foothills, forested; alt. 1,400 m.; $73^{o}58'W \times 4^{o}12'N$.

7. Hdas. Muriba and El Lobo
   Savanna and gallery fores alt. 250 m.; $70^{o}40'W \times 5^{o}2'N$.

8. Hato Las Margaritas.
   Savanna and gallery forest; alt. 250 m.; $70^{o}35'W \times 5^{o}2'N$.

9. Hato El Porvenir.
   Savanna and gallery forest; alt. 220 m.; $71^{o}22'W \times 4^{o}45'N$.

10. Hato Carimagua.
    Savanna and gallery forest; alt. 250 m.; $70^{o}12'W \times 4^{o}40'N$.

11. Finca Neblinas.
    Savanna and gallery forest; alt. 300 m.; $72^{o}06'W \times 4^{o}20'N$.

12. Finca La Angostura.
    Savanna and gallery forest; alt. 300 m.; $72^{o}20'W \times 4^{o}18'N$.

13. El Valle, Carmelo; alt. 1,000 m.; $76^{o}23'W \times 4^{o}5'N$.

14. El Valle, Dagua; alt. 700-900 m.; $76^{o}40'W \times 3^{o}43'N$.

Table 28 (continued)

15. Restrepo.
    Foothills; alt. 500 m.; 73°33'W x 4°11'N.

16. Finca Delicias.
    Savanna and gallery forest; alt. 300 m.; 72°06'W x 4°20'N.

17. Fincas Sta. Fé and Sta. Isabel.
    Savanna and gallery forest; alt. 300 m.; 72°00'W x 4°20'N.

18. Fincas Abelinera and La Union.
    Savanna and gallery forest; alt. 300 m.; 72°06'W x 4°15'N.

19. Fincas Balmoral, Algarrobos and El Carajo.
    Savanna and gallery forest; alt. 370 m.; 72°15'W x 4°48'N.

20. Fincas Porsiacaso, Argelia and El Vergel.
    Savanna and gallery forest; alt. 350 m.; 72°25'W x 5°20'N.

21. Corinto.
    Mountainous; alt. 2,500 m.; 72°45'W x 5°25'N.

22. Finca Las Delicias.
    Savanna and gallery forest; alt. 520 m.; 73°55'W x 3°15'N.

23. Finca Los Tigres.
    Foothills, alt. 480 m.; 73°50'W x 3°10'N.

24. Granja Turipana del ICA. (Near Monteria.)
    Coastal plains, deforested; alt. 30 m.; 75°50'W x 8°53'N.

25. Boca de Juriepe. (Near Puerto Carreño.)
    Savanna and gallery forest; alt. 200 m.; 67°25'W x 6°10'N.

26. Bajó del Avion.
    Savanna and gallery forest; alt. 200 m.; 68°00'W x 6°13'N.

27. La Regadera (Usme.)
    Mountainous; alt. 2,700 m.; 74°09'W x 4°24'N.

28. San Miguel (Sibaté.)
    Mountainous; alt. 2,700 m.; 74°16'W x 4°28'N.

29. Finca El Soche.
    Mountainous, forested; alt. 2,700 m.; 74°21'W x 4°31'N.

30. Fincas Monserrate and Pto. Escondido.
    Savanna and gallery forest; alt. 200 m.; 67°50'W x 6°10'N.

31. El Delirio (Hoya del Rio San Cristobal), Bogotá.
    Mountain, forested; alt. 2,900 m.; 74°3'W x 4°05'N.

TABLE No. 29

Bogota Branch Laboratory. Animals Captured per 100 Trap Nights, by Collecting Site and Month of Year

	1967						1968						1969						1970		
MONTHS	J-F	M-A	M-J	J-A	S-O	N-D	J-F	M-A	M-J	J-A	S-O	N-D	J-F	M-A	M-J	J-A	S-O	N-D	J-F	M-A	
SITES																					
1	4.7									3.6											2.8
2	5.9																				5.9
3							5.9														5.9
4	1.6	1.2																			1.4
5	2.9									2.2											2.5
6		1.2																			1.2
7		3.4																			3.4
8		0.9	0.7																		0.8
9			3.7																		3.7
10			2.9																		2.9
11				5.3			2.2	3.0													3.5
12										8.1											8.1
13					6.9																6.9
14											3.3										3.5
15										3.1											3.1
16							4.5														4.5
17							6.0														6.0
18							4.6														4.6
19								4.0	7.7												7.5
20									8.6									11.0			8.6
21									0.6												0.6
22											6.8										6.8
23												4.2							4.5		4.3
24												6.0									6.0
25																			3.0		3.0
26													0.1								0.1
27															1.7						1.7
28																4.2					4.2
29																	4.4				4.4
30																			3.5		3.5
31																				4.9	4.9
	3.8	1.7	2.7	5.3	6.9	-	4.6	3.5	5.6	4.3	5.0	5.1	0.1	-	1.7	4.2	4.4	11.0	3.7	4.9	4.3

Estimated (1967 J-F – 1968 J-A)

Accurately calculated (1968 S-O – 1970 M-A)

TABLE No. 30

VIRUS ISOLATIONS AS OF MAY 7, 1970

Strain No.	Species	Tissue	Animal No.	Date Captured	Collection Site	SM ic	SM ip	AM ic	AM ip	SH ic	SH ip	AH ic	AH ip	Chloroform Sensitivity	Tentative Identity	Reisolation
BeAn 20-10-38	<u>Didelphis marsupialis</u>	Organ pool	REM-175	IV-20-67	7	$6\text{-}10^{*}/10^{5*}$	NT	NT		NT		NT		NT	none	NT
BeAn 20-11-00	<u>Ameiva</u> sp.	Liver	REM-209	IV-25-67	7	$4\text{-}7/10^{3}$	NT	NS	NS	NS	NT	NS	NS	NT	none	NT
BeAn 20-11-23	<u>Zygodontomys brevicauda</u>	Organ pool	PSM-191	IV-26-67	7	$5\text{-}8/10^{2.5}$	7-9	NS	NS	3-13	11-14	8-12	NT	NT	none	NT
BeAn 20-17-79	<u>Zygodontomys brevicauda</u>	Organ pool	REM-315	VII-6-67	11	$5\text{-}6/10^{2}$	NT	NS	NS	5-9	NT	NS	NS	NT	none	NT
BeAn 20-26-61	<u>Dasyprocta fuliginosa</u>	Kidney	REM-320	VII-7-67	11	3-4	5	NS	NS	4-5	3-4	NT	NS	Yes	none	NT
BeAn 20-26-70	<u>Dasyprocta fuliginosa</u>	Spleen	REM-320	VII-7-67	11	5-6	5-6	NS	NS	3-4	2-4	NS	NS	Yes	none	NT
BeAn 21-63-45	<u>Proechimys guayannensis</u>	Spleen	REM-3164	XI-4-68	22	$1\text{-}2/10^{6}$	NT	4-6	5-6		2	3-4	2-4	Yes	VEE virus	Yes
BeAn 21-67-87	Rodent to be identified	Organ pool	REM-3540	VI-29-69	27	1-2	NT	NT	NT	NT	NT	NT	NT	NT	none	NT
BeAn 21-17-48	Rodent to be identified	Throat swab	REM-3550	VII-1-69	27	1-2	NT	NT	NT	NT	NT	NT	NT	NT	VEE virus	Yes
BeAn 21-17-71	Rodent to be identified	Throat swab	REM-3551	VII-1-69	27	1-2	NT	NT	NT	NT	NT	NT	NT	NT	VEE virus	Yes
BeAn 21-17-37	Rodent to be identified	Throat swab	REM-3553	VII-1-69	27	1-2	NT	NT	NT	NT	NT	NT	NT	NT	VEE virus	Yes
BeAn 21-16-34	<u>Sciurus granatensis</u>	Liver pool	REM-2545, 2546	IV-25-68	19	1-2	NT	NT	NT	NT	NT	NT	NT	NT	VEE virus	Yes
BeAn 20-65-98	<u>Proechimys guayannensis</u>	Liver pool	REM-2637, 2638, 2639 2657	VI-9-68 and VI-11-68	19	$1\text{-}2/10^{5.5}$	3	2-3	NS	1	1-2		NS	Yes	VSV-NJ	Neg.**
BeAn 20-64-65	<u>Didelphis marsupialis</u>	Organ pool	REM-2597	V-268	20	$1\text{-}2/10^{5.5}$	2-3	3-6	NS	1-2	1		NS	Yes	VSV NJ	Neg.**

SM = Suckling mice
AM = Adult mice
SH = Suckling hamsters

AH = Adult hamsters
ic = Intracerebral
ip = Intraperitoneal

NT = Not tested
NS = Not susceptible (as indicated by lack of clinical illness)

* = Survival time in days usually after several passages/titer in SM.
** = See Text

TABLE No. 31

FREQUENCY OF NEUTRALIZING ANTIBODY TO VSV-NJ AMONG SPECIES

BY COLLECTING SITES

	1	3,5	4	7,8	9,10	11,17,18	12	15	16	19	20	22	23	25	TOTAL	PERCENT
Ameiva sp.	0/1	0/2	0/1	0/5	0/2	1/22	0/2	---	1/9	1/11	0/5	1/15	0/1	0/12	4/88	5
Marmosa murina	---	2/5	---	0/2	0/1	0/1	---	---	---	0/1	0/3	---	---	0/3	2/16	12
Philander opossum	---	0/7	0/4	---	---	0/1	0/5	---	0/2	---	---	4/13	---	---	4/32	12
Metachirus nudicaudatus	0/2	0/2	0/3	0/6	---	0/1	0/4	---	---	---	---	0/5	0/1	---	0/[illegible]	0
Didelphis marsupialis	0/1	0/21	0/1	1/11	1/8	1/13	0/15	0/1	0/1	0/10	0/5	2/14	1/2	0/9	6/112	5
Lutreolina crassicaudata	---	---	---	---	---	0/6	---	---	0/2	---	---	---	---	---	0/8	0
Unidentified marsupial	---	---	---	---	---	---	0/1	---	---	---	---	0/1	---	---	0/2	0
Callicebus moloch	---	---	---	---	---	---	---	---	---	---	---	1/9	---	---	1/9	11
Alouatta seniculus	---	---	---	---	---	---	---	---	---	0/1	---	---	---	0/7	0/8	0
Cebus apella	---	---	---	---	---	---	---	---	---	---	---	0/7	0/4	---	0/11	0
Saimiri sciureus	---	---	---	---	---	---	---	---	---	---	---	0/2	0/3	---	0/5	0
Lagothrix lagothricha	---	0/4	---	---	---	---	---	---	---	---	---	---	---	---	0/4	0
Myrmecophaga tridactyla	---	---	---	---	---	---	---	---	---	1/2	1/1	---	0/1	---	2/4	50
Tamandua longicaudata	---	---	---	---	---	0/1	---	---	---	0/1	---	---	---	---	0/2	0
Dasypus sp.	---	---	---	---	0/2	---	0/3	---	---	0/2	0/1	---	---	---	0/8	0
Dusicyon (*Cerdocyon*) *thous*	0/1	---	---	---	---	---	---	---	---	2/2	0/1	---	---	---	2/4	50
Eira barbara	---	---	---	---	---	---	---	---	---	---	---	0/1	---	---	0/1	0
Felis pardalis	---	---	---	---	---	---	---	---	---	---	---	0/1	---	---	0/1	0
Tayassu sp.	0/6	---	---	---	---	---	---	---	---	---	---	---	0/1	---	0/7	0
Odocoileus virginianus	---	---	---	1/1	---	---	---	---	---	1/1	/5	---	---	0/1	4/8	50
Mazama gouazoubira	---	---	---	---	---	---	---	---	---	---	---	0/2	---	---	0/2	0
Sylvilagus floridanus	---	---	---	---	0/2	0/2	0/3	---	0/2	---	---	---	---	---	0/9	0
Sciurus granatensis	---	---	---	---	---	---	---	---	---	0/2	---	---	0/1	---	0/3	0
Oryzomys caliginosus	---	---	0/2	---	---	---	---	---	---	---	---	---	---	---	0/2	0
Oryzomys concolor	---	0/10	---	---	0/1	---	---	0/1	---	0/7	0/2	0/3	---	0/1	0/25	0

TABLE No. 31 (Continued)

	1	3,5	4	7,8	9,10	11,17,18	12	15	16	19	20	22	23	25	TOTAL	PERCENT
Holochilus brasiliensis	---	---	---	0/3	0/1	0/1	---	---	---	---	---	0/2	---	0/1	[illegible]	0
Nectomys spinosus	---	---	0/2	---	---	-	---	---	---	---	---	---	---	---	0/2	0
Nectomys squamipes	0/2	0/1	0/1	3/12	0/3	1/5	1/5	---	---	2/6	1/2	0/3	---	---	8/40	20
Zygodontomys brevicauda	---	0/3	---	0/1	---	0/3	---	0/1	---	0/2	0/1	---	---	---	0/11	0
Sigmodon (Sigmomys) alstoni	---	---	---	0/3	0/1	0/1	---	---	---	---	---	0/2	---	0/1	0/8	0
Proechimys guyanensis	0/31	2/63	0/1	---	0/16	1/44	1/60	0/2	0/6	17/31	0/9	3/101	0/10	---	24/374	6
Echimys sp.	---	---	---	---	---	---	---	---	---	---	---	---	---	0/1	0/1	0
Cavia porcellus	0/4	---	---	1/5	0/1	0/4	---	---	---	---	---	---	---	---	1/14	7
Hydrochoerus hydrochaeris	0/1	---	---	---	---	1/9	---	---	---	1/3	---	---	---	---	2/13	15
Dasyprocta fuliginosa	0/1	---	---	---	---	0/3	0/1	---	0/1	0/3	---	0/2	---	---	0/11	0
Agouti paca	---	---	---	---	---	---	---	---	---	0/2	---	---	---	---	0/2	0
Coendou sp.	---	---	---	---	---	---	---	---	---	---	---	---	---	0/1	0/[illegible]	0
Rattus rattus	---	---	0/1	---	---	0/10	---	0/3	0/1	---	---	---	---	0/4	0/19	0
Rattus sp.	---	---	---	---	---	---	---	0/2	---	---	---	---	---	---	0/2	0
Unidentified rodent	---	---	---	0/1	---	---	---	---	---	---	---	---	---	---	0/1	0
TOTAL	0/50	4/118	0/16	6/47	1/37	5/127	2/99	0/10	1/27	25/87	4/35	11/181	1/24	0/40	60/898	
Percent	0	3.4	0	12.8	2.7	3.9	2.0	0	3.7	29.0	11.4	6.4	4.1	0	6.7	

See Table 28 and Map 3 (Figure 3) for locations of collecting sites.

TABLE No. 32

FREQUENCY OF NEUTRALIZING ANTIBODY TO VSV-Ind AMONG SPECIES

BY COLLECTING SITES

	1	3,5	4	7,8	9,10	11,17,18	12	15	16	19	20	22	23	25	TOTAL	PERCENT
Ameiva sp.	0/1	0/2	0/1	0/5	0/2	0/23	0/2	0/1	0/10	0/11	0/6	0/17	0/1	0/12	0/94	0
Marmosa murina	0/1	0/5	—	0/2	1/2	1/5	—	—	—	1/4	0/5	—	—	0/3	3/27	11
Philander opossum	—	0/7	0/4	—	—	0/1	—	1/2	—	—	—	2/13	—	—	3/32	9
Metachirus nudicaudatus	0/2	0/2	0/3	0/6	—	0/1	0/4	—	—	—	—	0/5	0/1	—	0/24	0
Didelphis marsupialis	0/1	0/21	0/1	1/12	0/8	0/13	1/15	0/1	1/1	1/10	0/5	0/14	1/2	0/9	4/113	3
Lutreolina crassicaudata	—	—	—	—	—	0/6	—	—	0/1	—	—	—	—	—	0/7	0
Unidentified marsupial	—	—	—	—	—	—	0/1	—	—	—	—	0/1	—	—	0/2	0
Callicebus moloch	—	—	—	—	—	—	—	—	—	—	—	0/9	—	—	0/9	0
Alouatta seniculus	—	—	—	—	—	—	—	—	—	0/1	—	—	—	0/7	0/8	0
Cebus apella	—	—	—	—	—	—	—	—	—	—	—	0/7	0/4	—	0/11	0
Saimiri sciureus	—	—	—	—	—	—	—	—	—	—	—	0/2	0/3	—	0/5	0
Lagothrix lagothricha	—	0/4	—	—	—	—	—	—	—	—	—	—	—	—	0/4	0
Myrmecophaga tridactyla	—	—	—	—	—	—	—	—	—	0/2	1/1	—	0/1	—	1/4	25
Tamandua longicaudata	—	—	—	—	—	0/1	—	—	—	0/1	—	—	—	—	0/2	0
Dasypus sp.	—	—	—	—	0/2	—	0/3	—	—	0/2	1/1	—	—	—	1/8	12
Dusicyon (Cerdocyon) thous	0/1	—	—	—	—	—	—	—	—	0/2	0/1	—	—	—	0/4	0
Eira barbara	—	—	—	—	—	—	—	—	—	—	—	0/1	—	—	0/1	0
Felis pardalis	—	—	—	—	—	—	—	—	—	—	—	0/1	—	—	0/1	0
Tayassu sp.	2/6	—	—	—	—	—	—	—	—	—	—	—	0/1	—	2/7	29
Odocoileus virginianus	—	—	—	0/1	—	—	—	—	—	0/1	0/5	—	—	0/1	0/8	0
Mazama gouazoubira	—	—	—	—	—	—	—	—	—	—	—	0/2	—	—	0/2	0
Sylvilagus floridanus	—	—	—	—	1/2	0/2	0/3	—	0/2	—	—	—	—	—	1/9	11
Sciurus granatensis	—	—	0/1	—	—	—	—	—	—	2/2	—	—	0/1	—	2/4	50
Oryzomys caliginosus	—	—	0/2	—	—	—	—	—	—	—	—	—	—	—	0/2	0
Oryzomys concolor	—	1/11	—	—	0/1	—	—	0/1	—	1/7	0/2	0/3	—	0/1	2/26	8

TABLE No. 32 (Continued)

	1	3,5	4	7,8	9,10	11,17,18	12	15	16	19	20	22	23	25	TOTAL	PERCENT
Holochilus brasiliensis	---	0/2	---	---	---	0/1	---	---	0/7	---	---	---	---	---	0/9	0
Neacomys spinosus	---	---	0/2	---	---	0/[illegible]	---	---	---	---	---	---	---	---	0/8	0
Nectomys squamipes	0/3	0/1	0/1	0/12	0/3	---	0/7	---	---	0/9	0/2	0/3	---	---	0/41	0
Zygodontomys brevicauda	---	0/3	---	0/2	0/1	0/3	0/1	0/2	0/1	0/2	0/1	0/3	0/1	0/2	0/22	0
Sigmodon (Sigmomys) alstoni	---	---	---	0/3	0/1	0/1	---	---	---	---	---	0/2	---	0/1	0/8	0
Proechimys guyannensis	1/33	2.67	0/1	- -	0/16	0/45	0/60	0/2	0/6	0/48	0/9	1/102	0/12	---	4/401	1
Echimys sp.	---	---	---	---	---	---	---	---	---	---	---	---	---	0/1	0/1	0
Cavia porcellus	0/4	---	---	0/5	0/1	0/4	---	---	---	---	---	---	---	---	0/14	0
Hydrochoerus hydrochaeris	0/1	---	---	---	---	1/9	---	---	---	1/3	---	---	---	---	2/13	15
Dasyprocta fuliginosa	0/1	---	---	---	---	0/3	0/1	---	0/1	1/3	---	0/2	---	---	1/11	9
Agouti paca	---	---	---	---	---	---	---	---	---	0/2	---	---	---	---	0/2	0
Coendou sp.	---	---	---	---	---	---	---	---	---	---	---	---	---	0/1	0/1	0
Rattus rattus	---	---	0/1	---	---	0/10	----	0/3	0/1	---	---	---	---	0/4	0/19	0
Rattus sp.	---	---	---	---	---	---	---	0/3	---	---	---	---	---	---	0/3	0
Unidentified rodent	---	---	---	0/1	---	---	---	---	---	---	---	---	---	---	0/1	0
TOTAL	3/54	3/124	0/17	1/49	2/39	2/134	1/102	0/13	2/32	6/110	2/38	3/187	0/27	0/4[illegible]	25/968	
Percent	6	2	0	2	5	1	1	0	6	5	5	2	0	0		2.6

See Table 28 and Map 3 (Figure 3) for locations of collecting sites.

TABLE No. 33

FREQUENCY OF NEUTRALIZING ANTIBODY TO COCAL AMONG SPECIES

BY COLLECTING SITES

	1	3,5	4	7,8	9,10	11,17,18	12	15	16	19	20	22	23	25	TOTAL	PERCENT
Ameiva sp.	0/1	0/2	1/1	0/5	0/2	0/23	0/2	0/1	0/10	0/11	0/6	0/17	0/1	0/3	1/95	1
Marmosa murina	0/1	0/5	---	0/2	0/2	0/5	---	---	---	0/4	0/5	---	---	0/3	0/27	0
Philander opossum	---	1/7	0/4	---	---	0/1	0/5	---	0/2	---	---	0/13	---	---	1/32	3
Metachirus nudicaudatus	0/2	1/2	0/3	0/6	---	0/1	0/4	---	---	---	---	0/5	0/1	---	1/24	4
Didelphis marsupialis	1/1	0/20	0/1	0/12	0/8	0/13	0/14	1/1	0/1	0/10	0/5	3/14	0/2	0/9	7/111	6
Lutreolina crassicaudata	---	---	---	---	---	0/6	---	---	0/2	---	---	---	---	---	0/8	0
Unidentified marsupial	---	---	---	---	---	---	0/1	---	---	---	---	0/1	---	---	0/[illegible]	0
Callicebus moloch	---	---	---	---	---	---	---	---	---	---	---	0/9	---	---	0/[illegible]	0
Alouatta seniculus	---	---	---	---	---	---	---	---	---	0/1	---	---	---	0/7	0/8	0
Cebus apella	---	---	---	---	---	---	---	---	---	---	---	0/7	0/4	---	0/11	0
Saimiri sciureus	---	---	---	---	---	---	---	---	---	---	---	0/2	0/3	---	0/5	0
Lagothrix lagothrica	---	0/4	---	---	---	---	---	---	---	---	---	---	---	---	0/4	0
Myrmecophaga tridactyla	---	---	---	---	---	---	---	---	---	0/2	0/1	---	0/1	---	0/4	0
Tamandua longicaudata	---	---	---	---	---	0/1	---	---	---	0/1	---	---	---	---	0/2	0
Dasypus sp.	---	---	---	---	0/2	---	0/3	---	---	0/2	0/1	---	---	---	0/8	0
Dusicyon (Cerdocyon) thous	0/1	---	---	---	---	---	---	---	---	0/2	0/1	---	---	---	0/4	0
Eira barbara	---	---	---	---	---	---	---	---	---	---	---	0/1	---	---	0/1	0
Felis pardalis	---	---	---	---	---	---	---	---	---	---	---	0/1	---	---	0/1	0
Tayassu sp.	0/6	---	---	---	---	---	---	---	---	---	---	---	0/1	---	0/7	0
Odocoileus virginianus	---	---	---	0/1	---	---	---	---	---	0/1	0/5	---	---	0/1	0/8	0
Mazama gouazoubira	---	---	---	---	---	---	---	---	---	---	---	1/2	---	---	1/2	50
Sylvilagus floridanus	---	---	---	---	0/2	0/2	0/3	---	0/2	---	---	---	---	---	0/9	0
Sciurus granatensis	---	---	0/1	---	---	---	---	---	---	0/2	---	---	0/1	---	0/4	0
Oryzomys [illegible]	---	---	0/2	---	---	---	---	---	---	---	---	---	---	---	0/2	0
Oryzomys concolor	---	0/11	---	---	0/1	---	---	0/1	---	0/7	0/2	0/3	---	0/1	0/26	0

TABLE No. 33 (Continued)

	1	3,5	4	7,8	9,10	11,17,18	12	15	16	19	20	22	23	25	TOTAL	PERCENT
Holochilus brasiliensis	---	0/1	---	---	---	0/1	---	---	0/7	---	---	---	---	---	0/9	0
Neacomys spinosus	---	---	0/2	---	---	---	---	---	---	---	---	---	---	---	0/2	0
Nectomys squamipes	0/3	0/1	0/1	0/12	0/3	0/6	0/7	---	---	0/9	0/2	0/3	---	---	0/47	0
Zygodontomys brevicauda	---	1/3	---	0/2	0/1	0/3	0/1	0/2	0/1	0/2	0/1	0/3	0/1	0/2	1/22	4
Sigmodon (Sigmomys) alstoni	---	---	---	0/3	0/1	0/1	---	---	---	---	---	0/2	---	0/1	0/8	0
Proechimys guyannensis	2/33	26/67	0/1	---	0/16	0/45	2/58	0/2	0/6	2/48	0/9	14/102	5/12	---	51/399	13
Echimys sp.	---	---	---	---	---	---	---	---	---	---	---	---	---	0/1	0/1	0
Cavia porcellus	0/4	---	---	0/5	0/1	0/4	---	---	---	---	---	---	---	---	0/14	0
Hydrochoerus hydrochaeris	1/1	---	---	---	---	0/9	---	---	---	0/3	---	---	---	---	1/13	8
Dasyprocta fuliginosa	0/1	---	---	---	---	0/3	0/1	---	0/1	0/3	---	0/2	---	---	0/11	0
Agouti paca	---	---	---	---	---	---	---	---	---	2/2	---	---	---	---	2/2	100
Coendou sp.	---	---	---	---	---	---	---	---	---	---	---	---	---	0/1	0/1	0
Rattus rattus	---	---	0/1	---	---	0/10	---	1/3	0/1	---	---	---	---	0/4	1/19	5
Rattus sp.	---	---	---	---	---	---	---	1/3	---	---	---	---	---	---	1/3	33
Unidentified rodent	---	---	---	0/1	---	---	---	---	---	---	---	---	---	---	0/1	0
TOTAL	4/54	29/123	1/17	1/49	0/39	0/134	2/99	3/13	0/33	5/110	0/38	18/187	5/27	0/43	64/966	
Percent	7	23	6	2	0	0	2	23	0	4	0	10	19	0		6.7

See Table 28 and Map 3 (Figure 3) for locations of collecting sites.

Table 34

Prevalence of Neutralizing Antibody (Plaque Reduction)
For VSV-NJ Virus in Domestic Animals
(Sites 3,5,19 and 23 combined)

Age (Years)	Equines		Bovines		Total	
	*	%	*	%	*	%
< 1	1/4	25	12/24	50	13/28	46
1	2/7	29	9/19	47	11/26	42
2-3	13/41	32	6/27	22	19/68	28
4-5	12/28	43	14/26	54	26/54	48
6-7	17/30	57	12/26	46	29/56	52
8-9	13/32	41	6/18	33	19/50	38
≥ 10	22/33	67	4/16	25	26/49	53
Unknown	1/2	50	2/9	22	3/11	27
TOTAL	81/177	46	65/165	39	146/342	43

* No.positive/No.tested

Table 35

Prevalence of Neutralizing Antibody (Plaque Reduction) for VSV-Ind Virus in Domestic Animals (Sites 3,5,19 and 23 combined)

Age (years)	Equine		Bovines		Total	
	*	%	*	%	*	%
< 1	1/4	25	2/24	8	3/28	11
1	0/7	0	4/19	21	4/26	15
2-3	4/41	10	3/27	11	7/68	10
4-5	5/28	18	4/26	15	9/54	17
6-7	14/30	47	4/26	15	18/56	32
8-9	10/32	31	1/18	6	11/50	22
≥ 10	18/33	55	3/16	19	21/49	43
Unknown	1/2	50	1/9	11	2/11	18
TOTAL	53/177	30	22/165	13	75/342	22

* No. positive/No. tested

Table 36

Prevalence of Neutralizing Antibody (Plaque Reduction) for Cocal Virus in Domestic Animals (Sites 3,5,19 and 23 combined)

Age (Years)	Equines		Bovines		Total	
	*	%	*	%	*	%
< 1	0/4	0	0/24	0	0/28	0
1	0/7	0	0/19	0	0/26	0
2-3	0/41	0	2/27	7	2/68	3
4-5	1/28	4	1/26	4	2/54	4
6-7	4/30	13	2/26	8	6/56	11
8-9	2/32	6	1/18	6	3/50	6
≥ 10	3/33	9	2/16	13	5/49	10
Unknown	0/2	0	0/9	0	0/11	0
TOTAL	10/177	7	8/165	5	18/342	5

* No. positive/No. tested

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Universidad del Valle Department of Preventive Medicine Cali, Colombia	2a. REPORT SECURITY CLASSIFICATION 2b. GROUP

3. REPORT TITLE

DISEASE ECOLOGY OF TACARIBE GROUP VIRUSES IN NORTHWESTERN SOUTH AMERICA

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Final

5. AUTHOR(S) (First name, middle initial, last name)

Carlos Sanmartin
Ronald B. Mackenzie
Harold Trapido

6. REPORT DATE 30 April 1970	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS

8a. CONTRACT OR GRANT NO. AFOSR-68-1558	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO 9777	
c. 61102F	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d. 681312	AFOSR 70-1816 TR

10. DISTRIBUTION STATEMENT

1. This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Office of Scientific Research 1400 Wilson Boulevard (SRLA) Arlington, Virginia 22209

13. ABSTRACT

The central theme of this project has been the study of various aspects of the disease ecology of the Tacaribe group of arboviruses. The Tacaribe group includes two viruses, Junin and Machupo, which have been found to be the etiological agents of severe human diseases, Argentinian and Bolivian haemorrhagic fevers. Other agents of the group are Tacaribe virus isolated from bats and mosquitoes in Trinidad, and Amapari virus known from rodents and certain of their ectoparasites from an area north of the mouth of the Amazon River in Brazil. In 1965 the present investigators found another agent of this group near Cali, Colombia, which they named Pichinde virus for the mountain valley from which it was first isolated. Since that time workers at the Middle America Research Unit and the National Communicable Disease Center have isolated additional viruses of the group from Paraguay and Florida (USA), although the descriptions of these agents have not yet been published.

With the exception of Tacaribe, these viruses have all been found to be associated with New World cricetine rodents and most of the field effort of the present investigators has therefore been directed toward the collection of indigenous small mammals to obtain materials for virological and serological study. For the authentication of the source of these materials, zoological study skins and skulls of animals captured have been prepared and catalogued. Ectoparasites associated with captured animals have also been collected and either preserved for taxonomic study or processed for possible virus isolation. These field materials have values apart from the immediate purpose for which they were obtained: tissue specimens have yielded agents other than Tacaribe group viruses; serum specimens have been and will continue to be of use for serological study of the host and geographical distribution and incidence of a variety of viruses and other pathogens; mammal skins and skulls and ectoparasites are of use for taxonomic study by specialists in the various zoological and parasitological groups represented.

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